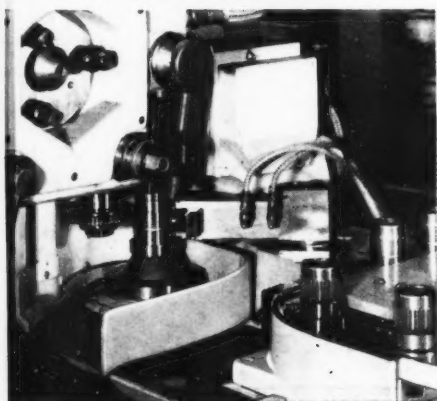
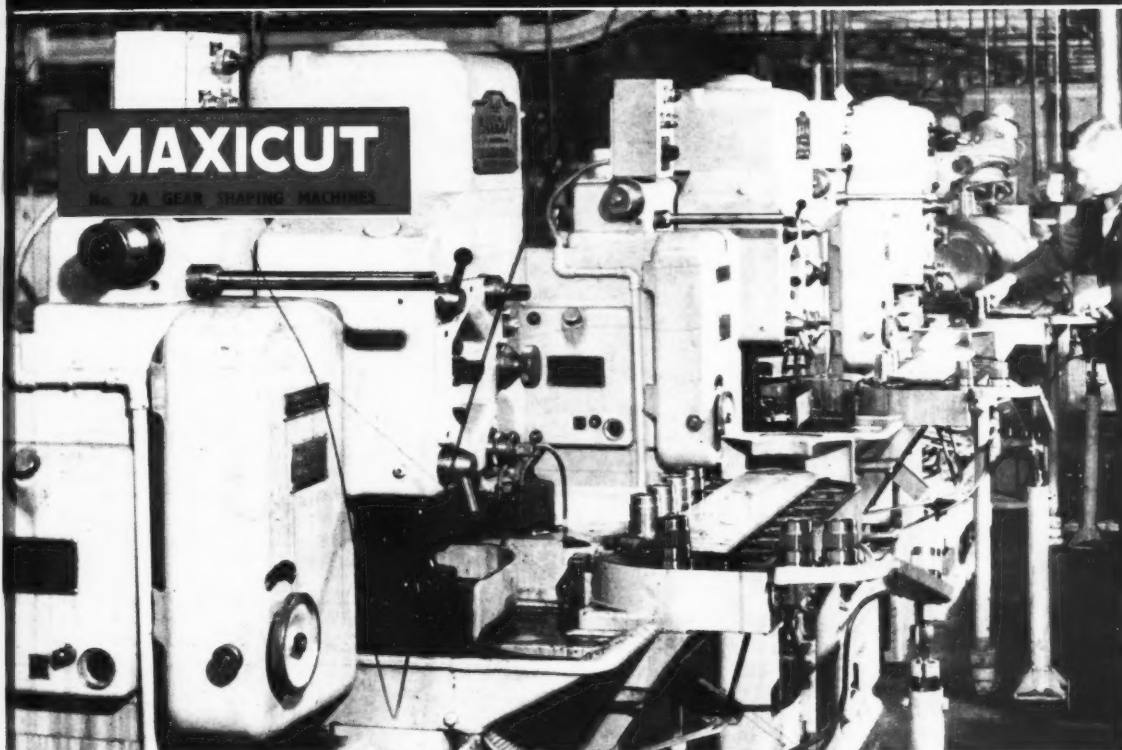


# MACHINERY

SEPTEMBER 20, 1961

ONE SHILLING & THREEPENCE



## For fast, automatic mass-production of gears

This line of Maxicut 2A Gear Shapers is installed at the Austin Motor Co. Ltd., for cutting Austin Seven Crankshaft Primary Gears. These Drummond Gear Shapers are equipped with swinging arm type loaders for completely automatic production.

**DRUMMOND BROS. LTD.**  
GUILDFORD · ENGLAND

Member of the Asquith Machine Tool Corporation

This view shows the swinging arm loader in its position after loading the blank.

*Sales and Service for the British Isles*

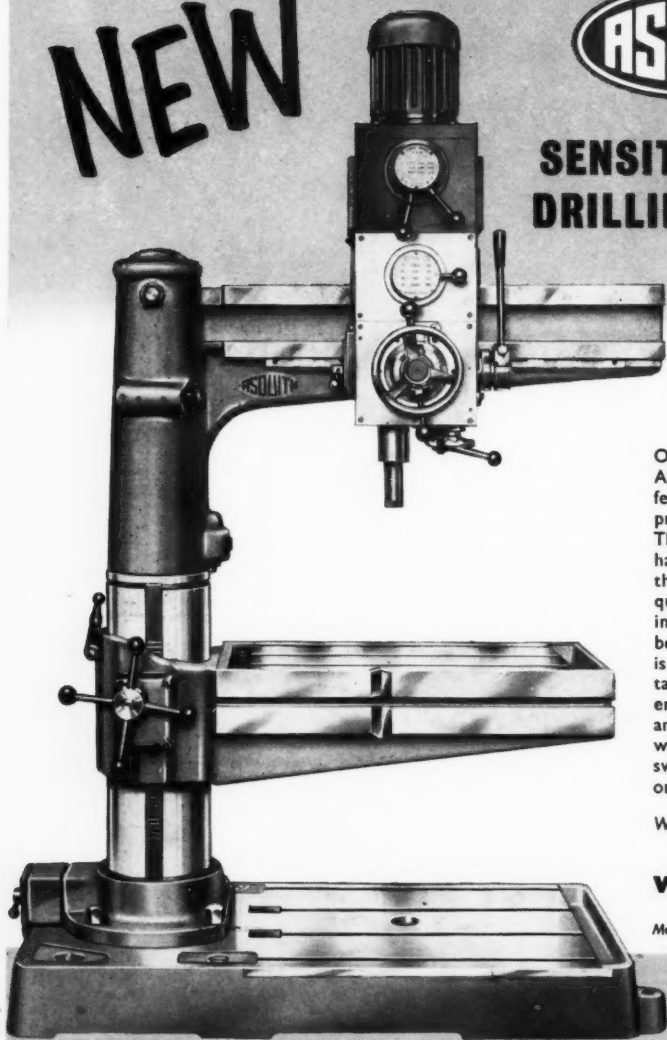
**DRUMMOND-ASQUITH LIMITED**

*Member of the Asquith Machine Tool Corporation*

# NEW



## SENSITIVE RADIAL DRILLING MACHINE



Of completely new design, this Asquith Radial incorporates many features that contribute to higher productivity.

The spindle, of self-contained design, has a range of nine spindle speeds (in three alternative ranges) and, if required, a slide with four power feeds in addition to the sensitive feed can be supplied as an extra. The spindle is bored No. 3 Morse Taper. The table has a long bearing on the pillar, ensuring rigidity and is adjustable up and down by rack and pinion through worm gearing. This table can be swung away for mounting large work on the baseplate.

Write today for full details

**WILLIAM ASQUITH LTD.**  
HALIFAX · ENGLAND

*Member of the Asquith Machine Tool Corporation*

**Built in a range of sizes with maximum radius 32 in., 40 in. or 48 in.**

*Sales and Service for the British Isles*

**DRUMMOND-ASQUITH LIMITED**

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KING EDWARD HOUSE, NEW ST., BIRMINGHAM Phone: Midland 3431. Also at LONDON Phone: Trafalgar 7224 & GLASGOW Phone: Central 0922



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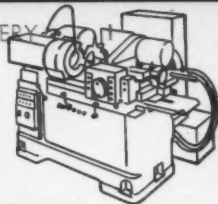


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# HERE'S HOW HEALD

September 20, 196

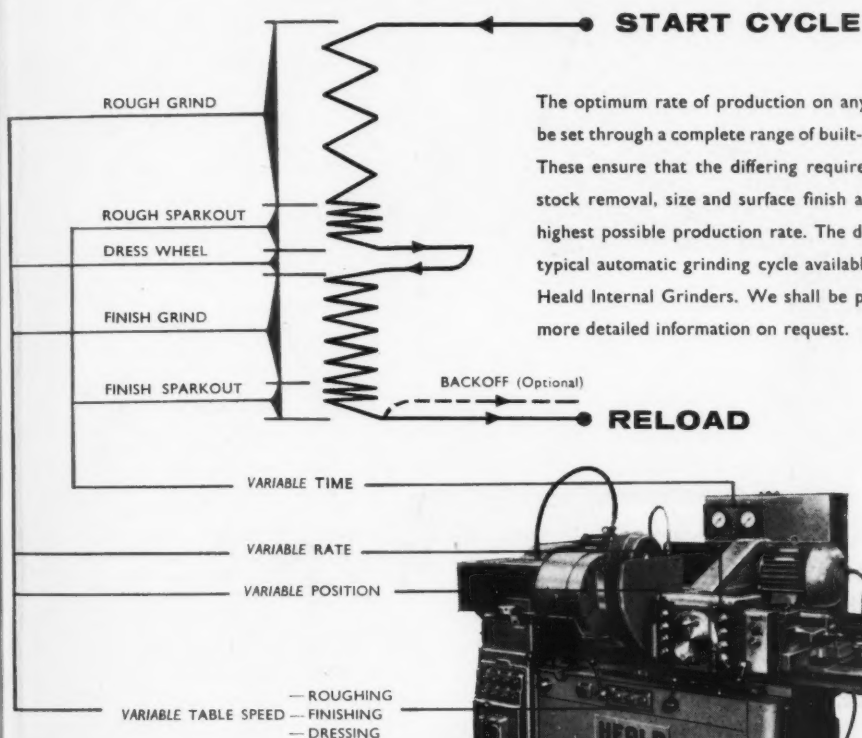
MACHINERY



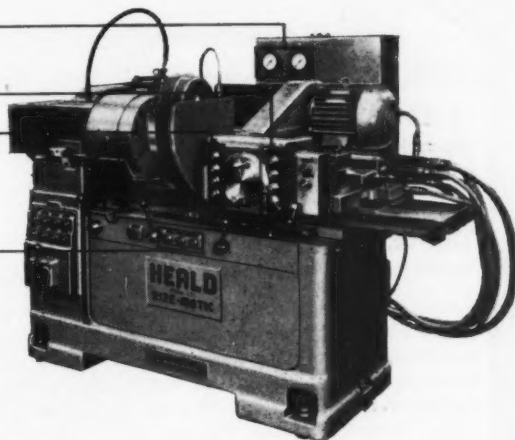
## INTERNAL GRINDERS

achieve

**MAXIMUM PRODUCTION**



The optimum rate of production on any particular job can be set through a complete range of built-in variable controls. These ensure that the differing requirements of material, stock removal, size and surface finish are fully met at the highest possible production rate. The drawing illustrates a typical automatic grinding cycle available on many sizes of Heald Internal Grinders. We shall be pleased to send you more detailed information on request.



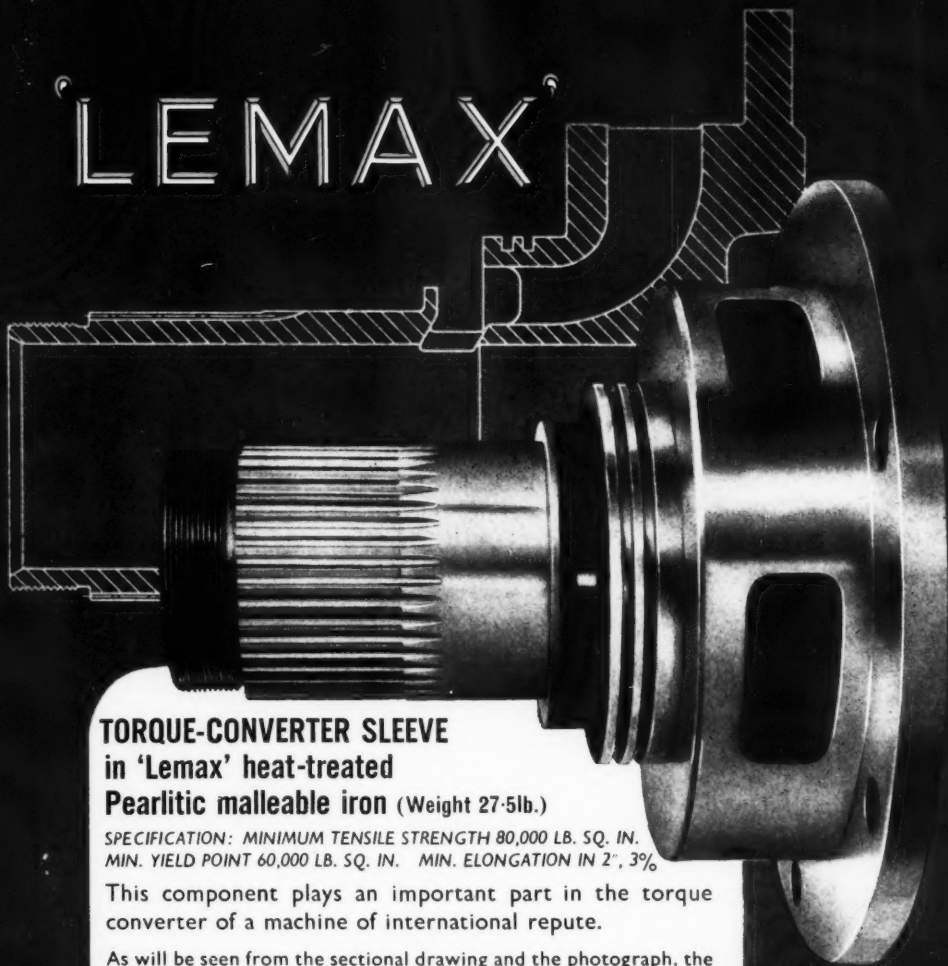
*You'll find IT PAYS to come to—*

# HEALD

HEALD MACHINES LIMITED • BIRMINGHAM 24 • ENGLAND  
Sales Representatives: ALFRED HERBERT LIMITED • COVENTRY



# LEMAX



**TORQUE-CONVERTER SLEEVE**  
in 'Lemax' heat-treated  
Pearlitic malleable iron (Weight 27.5lb.)

SPECIFICATION: MINIMUM TENSILE STRENGTH 80,000 LB. SQ. IN.  
MIN. YIELD POINT 60,000 LB. SQ. IN. MIN. ELONGATION IN 2", 3%

This component plays an important part in the torque converter of a machine of international repute.

As will be seen from the sectional drawing and the photograph, the sleeve embodies ducts for the hydraulic fluid, and is extensively machined. 'Lemax' heat-treated pearlitic malleables have versatile attributes, the ability to cast cored ducts of three-dimensional curvature, in combination with great mechanical strength, adequate shock resistance and the requisite degree of hardness.

LEY'S MALLEABLE CASTINGS COMPANY LIMITED  
DERBY, ENGLAND

TELEPHONE: DERBY 45671

Regd. Trade Marks:  
'Black Heart', 'Leys', 'Lepaz', 'Lemax'

# LEY'S









**One Vauxhall  
cluster gear blank  
handled automatically  
and machined for  
gear cutting  
every 45 seconds!**



***Ryder***  
**does it this way . . .**

At Vauxhall Motors Ltd., Luton, a RYDER 8-station No. 10 Verticalauto completes all exterior machining of cluster gear blanks automatically in two distinct sequences. The two loading arms work simultaneously, lifting the components from the conveyor and returning them on completion of each stage. Here is all the speed, precision and control associated with special equipment—achieved on a standard machine fitted with auto loading and unloading. The versatile No. 10 Verticalauto, with its great work capacity and ability to reduce labour costs can surely solve a production problem for you. Six-spindle and twin-six-spindle models are also available and are equally flexible in their adaptability.

**THOMAS RYDER & SON LIMITED,  
TURNER BRIDGE WORKS,  
BOLTON, ENGLAND.**

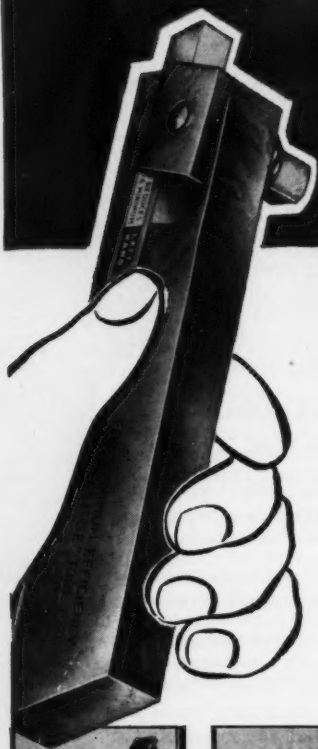
**See**

***Ryder***

**about automatics and auto-handling**

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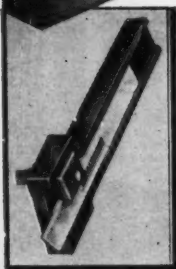
# for cutting efficiency



## Eclipse

### tool bits, lathe tools and tool holders

"Eclipse" tool holders are manufactured with the utmost care from high quality materials, are carefully heat treated and incorporate a number of special features which enable them to do their job superbly well. To complete the list of tools for turning and metal cutting, there is also the extensive range of "Eclipse" tool bits and lathe tools. Made from "Eclipse" H3 Cobalt High Speed Steel, these tools are carefully heat treated to give the perfect combination of hardness and toughness—tools which can be relied upon to maintain a keen cutting edge.

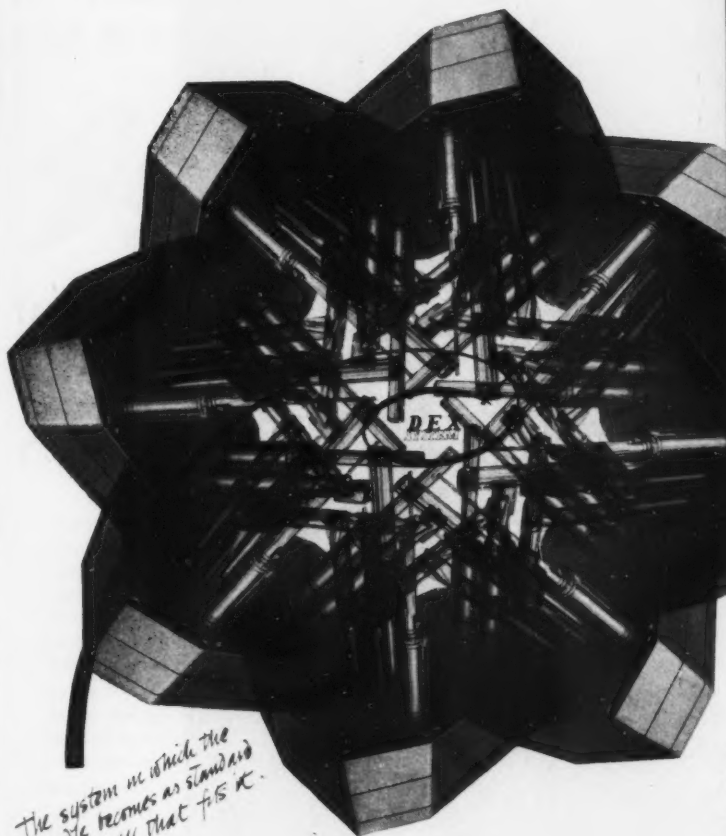


MADE BY

James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors



## Multi Drilling



*The system in which the spindle becomes as standard as the drill that fits it.*

**DEX**  
**SYSTEM** multi  
drilling gives Multi-  
Head standardization

Off the shelf service  
for standard parts

Savings in drawing  
office time

Lower manufacturing  
costs and speeds up  
your tooling  
programmes.

*An extensive  
organisation devoted  
to the design and  
manufacture of multi  
drilling equipment.*

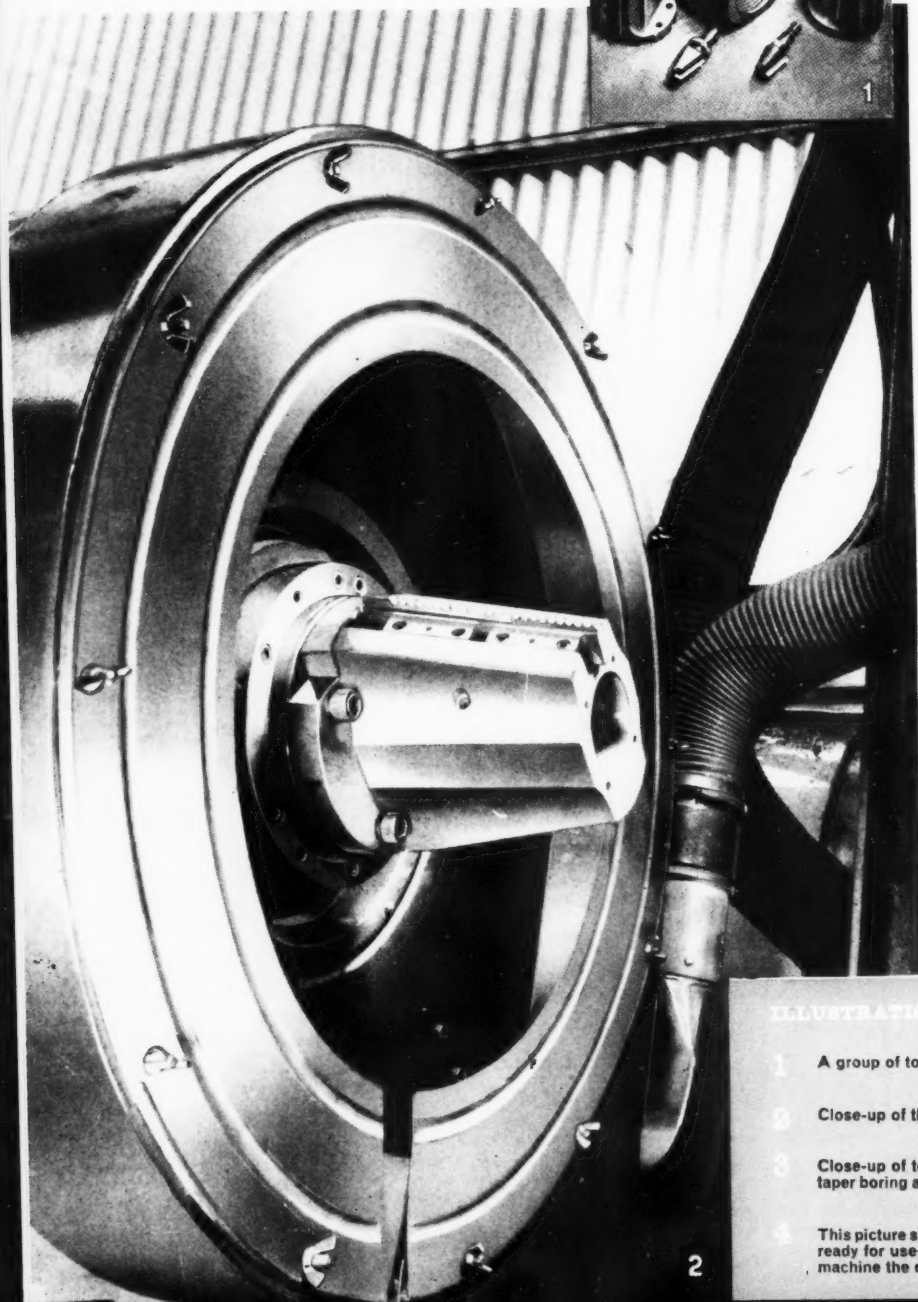
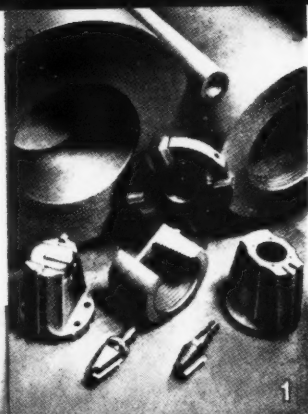
Designex (Coventry) Limited,  
Coventry Road,  
Exhall, Coventry.  
Phone Bedworth 2081

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# TAPER BORING

and



## ILLUSTRATIONS

- 1 A group of tools and components.
- 2 Close-up of thread milling cutter.
- 3 Close-up of tools on machine for taper boring and facing operation.
- 4 This picture shows the two machines ready for use—on the right hand machine the component is shown.

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# THREAD MILLING GRAPHITE ELECTRODES at

**ANGLO GREAT LAKES  
CORPORATION Ltd.**  
with specially designed

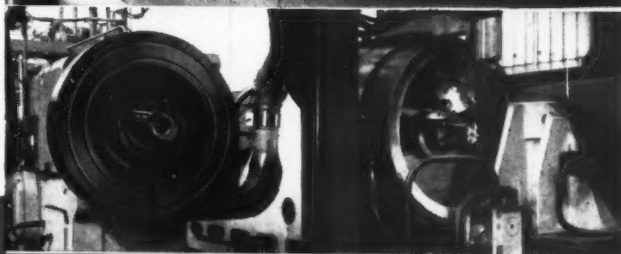
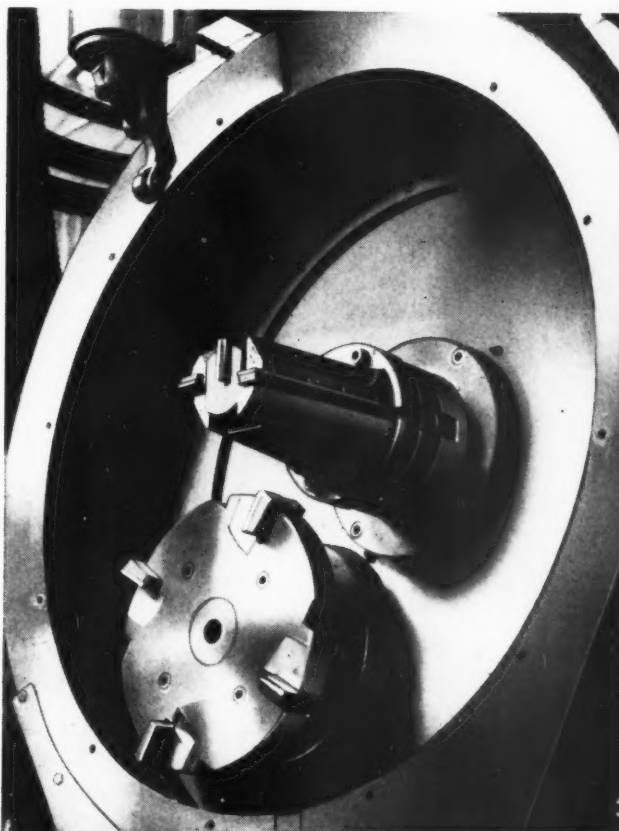
***Galtona***

## INSERTED BLADE TAPER BORING, FACING AND THREAD MILLING CUTTERS

We illustrate one set of a range of tools supplied for milling graphite electrodes. The facing head shown on Fig. 3 has standard Galtona type serrated blades, carbide tipped, whilst the taper boring cutter has tipped blades held by means of wedges and screws, with one blade cutting to centre.

At Fig. 2 we show a thread milling cutter, having one blade in T.15 high speed steel secured by wedges and screws, with fine adjustment to facilitate setting-up.

We welcome enquiries for all types of inserted blade cutters, for which proposal drawings are submitted without obligation.



# **RICHARD LLOYD LIMITED**

**GALTON HOUSE, ELMFIELD AVENUE, TYBURN, BIRMINGHAM, 24**

Telephone: Ashfield 1801, Telegrams "Cogs, Birmingham"

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LONDON AREA OFFICE: 240 Romford Road, Forest Gate, London, E7. Phone: MARYland 7304-5.  
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## make certain of that with **SUPER CAPITAL TOOL BITS**

**EXTRA  
LIFE**

### CAT'S WHISKER POINTS TO NOTICE:—

★ HIGH CARBON - HIGH VANADIUM - HIGH SPEED.

★ EXTREME RESISTANCE TO ABRASION.

★ FOR ROUGH AND FINISH TURNING OF TOUGHEST MATERIALS.

★ PRODUCTION CONTROLLED AND TESTED IN BALFOUR'S OWN WORKS FROM THE MELT TO THE FINISHED PRODUCT

★ AVAILABLE IN SHEFFIELD, AND FROM BRANCH OFFICE STOCKS IN LONDON, BIRMINGHAM, MANCHESTER, GLASGOW AND CARDIFF.

STEEL & TOOLS

**ARTHUR BALFOUR**

FOR THE WORLD

ARTHUR BALFOUR & CO LTD. CAPITAL STEEL WORKS, SHEFFIELD ENGLAND.  
ASSOCIATED COMPANY: THE EAGLE & GLOBE STEEL CO, LTD.



## AT ACCLES & POLLOCK

### improved results by use of Purolator filters

In drawing  $\frac{3}{4}$ " tubing for refrigerators Accles & Pollock use a specially developed oil in the drawing head.

Purolator bulk filters remove the scale and other abrasives from the oil, and effect a considerable saving in the operations involved.

*In circle: The Purolator filter.*

ONE OF THE  
**AUTOMOTIVE  
PRODUCTS**  
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# PUROLATOR

REGD. TRADE MARKS: PUROLATOR

**AUTOMOTIVE PRODUCTS COMPANY LIMITED**  
LEAMINGTON SPA, WARWICKSHIRE, ENGLAND



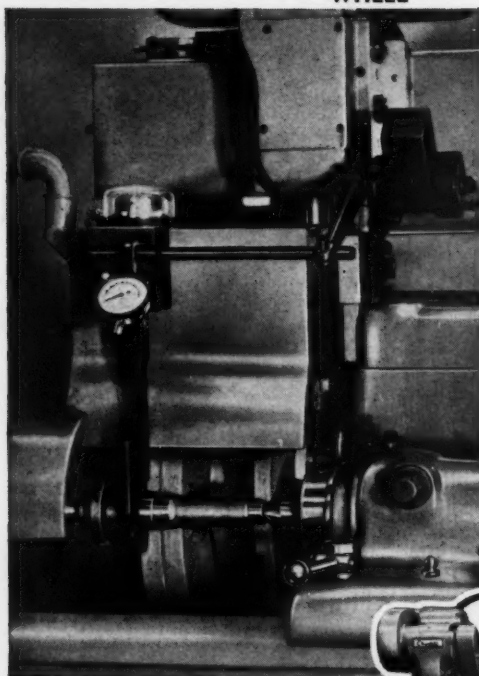
# AUTOMATIC

**SIZING  
OF  
WORKPIECE**

**TRUING  
OF  
GRINDING  
WHEEL**

**COMPENSATION  
FOR  
WHEEL  
TRUING**

**CYCLE CONTROL  
FOR NUMBER OF  
WORKPIECES**

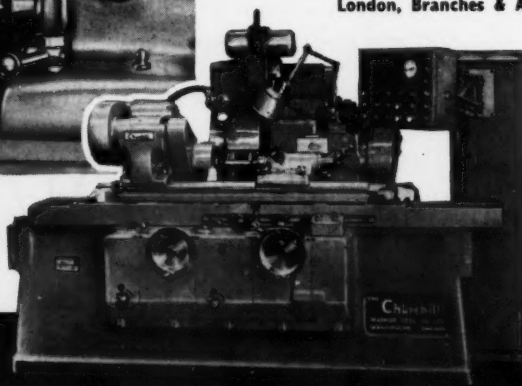


on  
*Model 'BW'*  
*Plain*  
*Grinding Machine*

**THE CHURCHILL MACHINE TOOL**  
Broadheath, nr. Manchester. Co Ltd  
Altrincham 3262

Export Sales Organisation  
**ASSOCIATED BRITISH MACHINE TOOL MAKERS LTD**  
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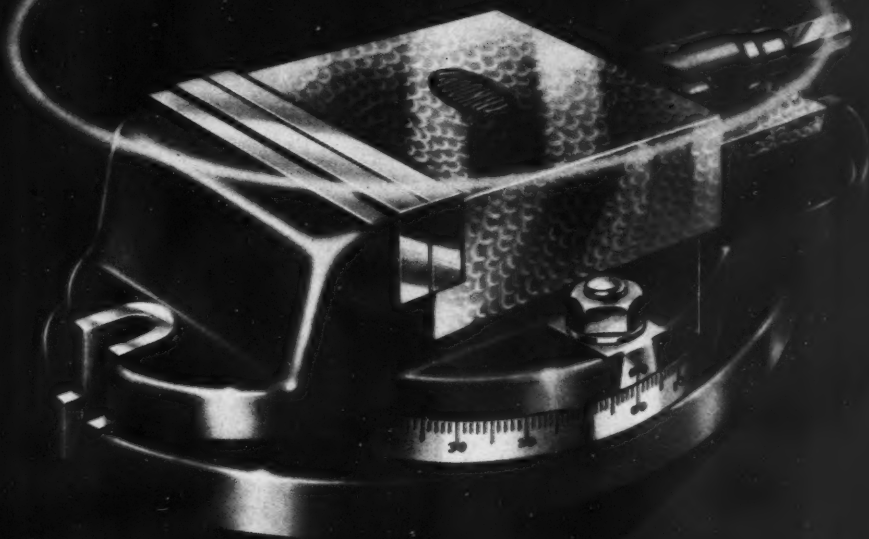
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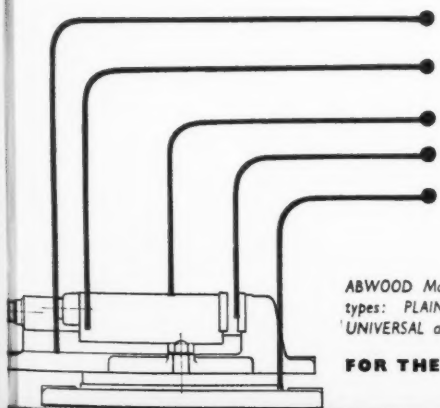


# THE VICE

*with all the virtues*



**THE TOOLROOM & PRODUCTION NO TRAPS FOR SWarf, LOW HEIGHT WITH RIGIDITY**



V SLIDES ADJUSTABLE FOR WEAR. LONG BEARING SURFACES. IMPOSSIBLE FOR THE JAW TO LIFT AND TILT THE JOB.

TOTALLY ENCLOSED SCREW WHICH CANNOT BECOME SEIZED OR BRUISED.

SLIDING JAW MACHINED OVER ITS WHOLE SURFACE FOR THE USE OF THE SCRIBING BLOCK.

GROUND TOOL STEEL JAWS AND PHOSPHOR BRONZE NUT

ACCURATELY MACHINE DIVIDED SWIVEL BASES INDEXED FULLY THROUGH 360°.

ABWOOD Machine Vices are available in the following types: PLAIN, SWIVEL TYPE (illustrated), SHAPER, UNIVERSAL and UNIVERSAL COMPOUND ANGLE TABLES.

**FOR THE TOOLROOM & PRODUCTION**



**ABWOOD MACHINE TOOLS LIMITED**

PRINCES ROAD, DARTFORD, KENT.

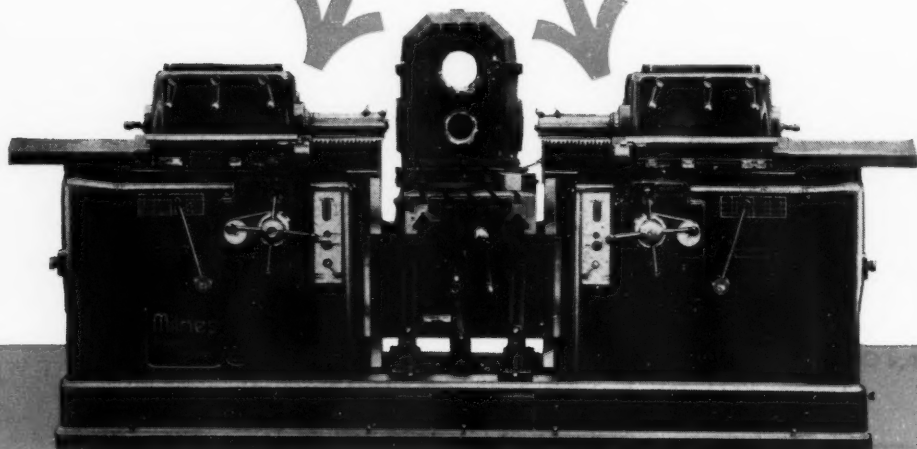
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# MILNES

**DOUBLE ENDED  
HEAVY DUTY  
FINE BORING MACHINE**

**BOTH**  
spindles cutting  
**SIMULTANEOUSLY**  
for maximum  
efficiency



*Plus!*

**CO-ORDINATE SETTING  
15° VERTICALLY 30° HORIZONTALLY  
AND 4 POSITION INDEXING**

**HENRY MILNES LIMITED**

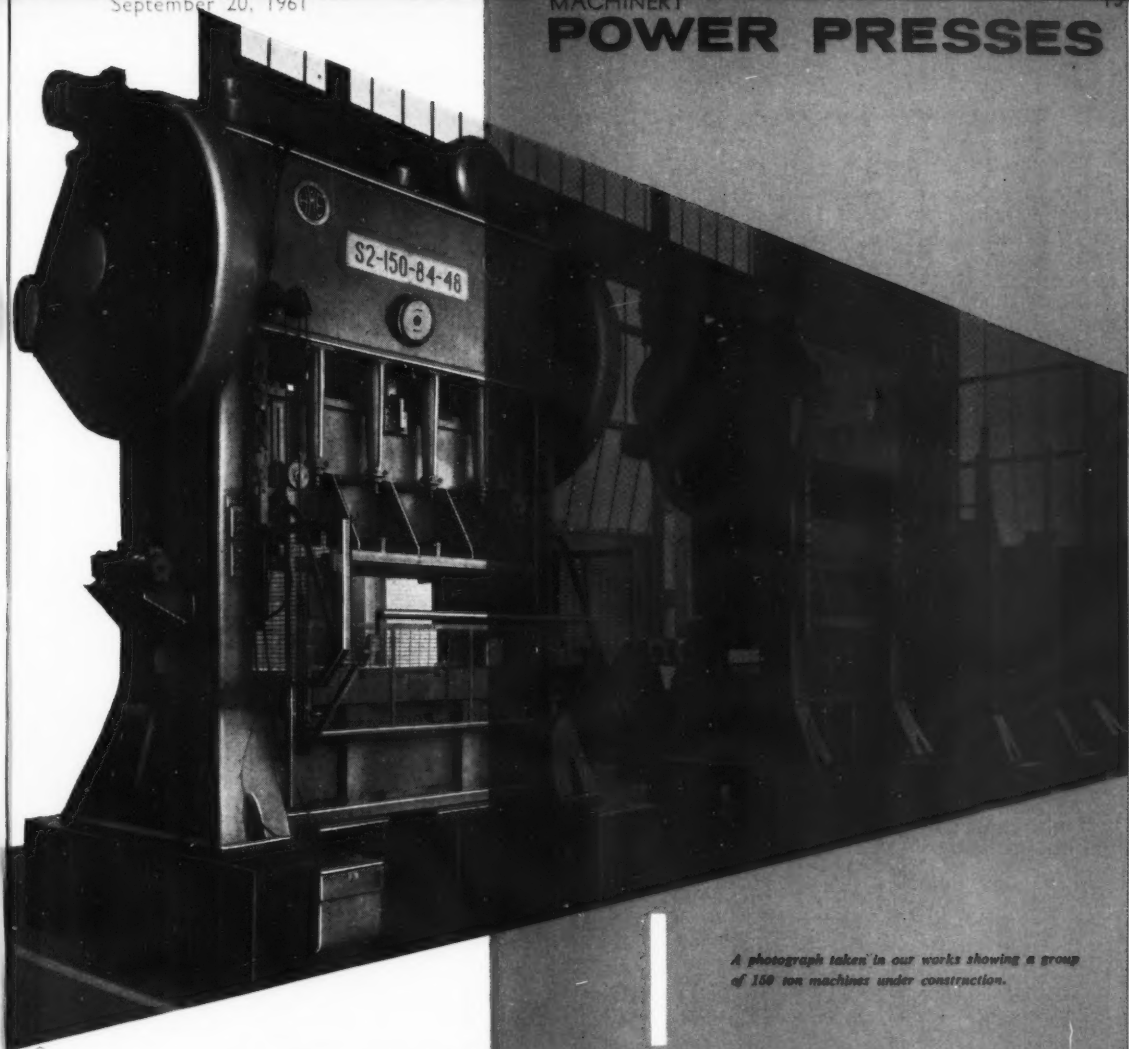
INGLEBY WORKS, ROSSE STREET, BRADFORD 8, YORKS  
TELEPHONE: BRADFORD 41301 TELEGRAMS: MILTOOLS, BRADFORD

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September 20, 1961

MACHINERY

# POWER PRESSES



*A photograph taken in our works showing a group of 150 ton machines under construction.*



The construction of presses in the larger range, has become a production line affair. Send for details of the features of these machines or, should you prefer, we will be pleased to arrange for one of our specialist engineers to call.

## HORDERN, MASON & EDWARDS LTD

BIRMINGHAM 24, ENGLAND.

London Office: VERNON PLACE, SOUTHAMPTON ROW, W.C.1.

Manchester Office: 2, ST. JOHN STREET, DEANSgate, 3.

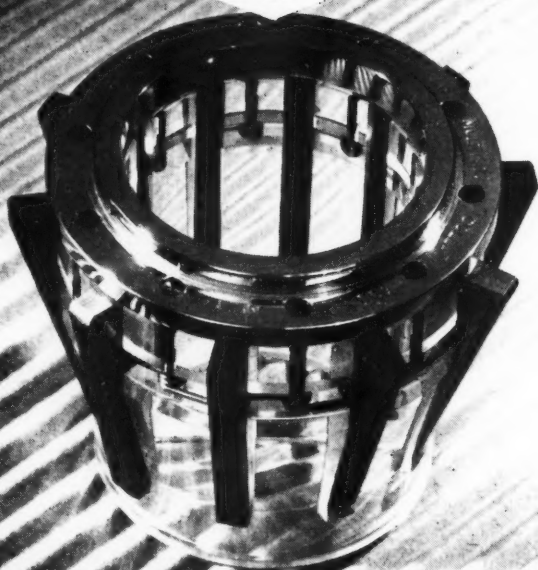
Tel.: ASHfield 1671

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## this is a "multisize" collet



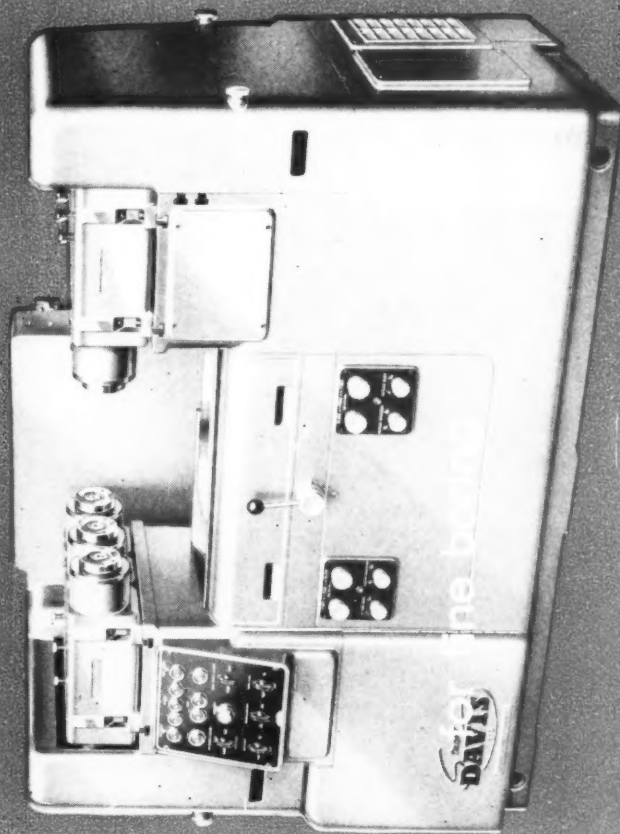
It has a stepless gripping range of  $1/8"$ , equivalent to the gripping capacity of at least ten spring collets. Sizes are available covering a total range from  $1/16"$  to  $2\frac{1}{2}"$ . It is the heart of the "multisize" collet system of workholding and toolholding. All "multisize" collets in any type range are interchangeable.

to find out more about "multisize" write or phone:

**F. BURNERD & CO. LTD. MOORSIDE WORKS, WINCHESTER, ENGLAND.**  
London Office: 5, Balfour Place, London, W.1. Telephone Winchester 5195

## BRITISH AND BEST BORERS BY STUART DAVIS

A range of single and double end fine borers; universal production tools of outstanding versatility unmatched for speed and economy.



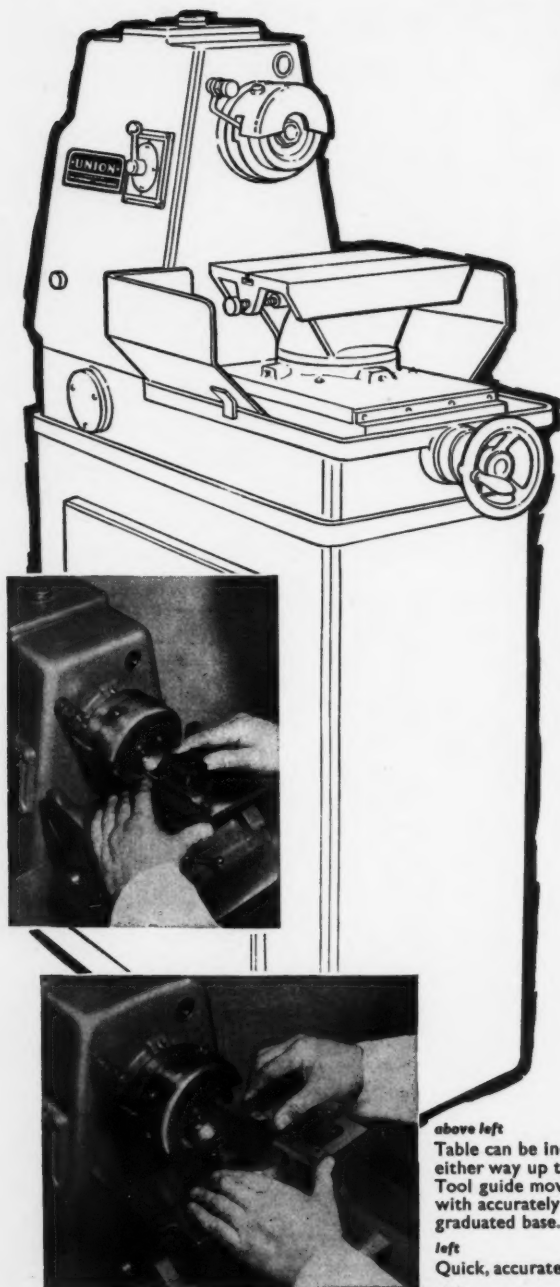
### EXCLUSIVE FEATURES

Absolute reliability from a unique combination of hydraulic and electrical controls eliminating frustrating downtime. Ability to commence production at the first switch on — no waiting for oil temperatures to rise. Exclusive design of valve spools and hydraulic circuit eliminates spongy and varying feed rates. Complete hydraulic gear and electrical gear separate from machine is easily maintained.

*Stuart*  
**DAVIS**

# FINE BORING

MACHINERY



# GET MORE FROM YOUR CARBIDE TOOLS

*with this inexpensive,  
robustly built*

## **UNION** LAPPING AND CHIPBREAKER GRINDING MACHINE

Lapping carbide tools after grinding improves performance, prolongs re-grinding intervals and gives a superior finish to the turned part.

### **BRIEF SPECIFICATION:**

4,800 r.p.m. spindle on opposed Timken bearings.  
Lapping speed 5,000 surface f.p.m.  
In-built coolant pump and tank.  
Fully adjustable table on ball bearing slideways.  
Supplied as bench or cabinet model



*above left*  
Table can be inclined  
either way up to 20°.  
Tool guide moves 90°  
with accurately  
graduated base.

*left*  
Quick, accurate setting.

*right*  
Vertical feed with adjust-  
able micrometer dials.

Literature available covers the Harrison range of  
Lathes from 9" to 17" swing: Milling, Drilling and  
Grinding Machines and Engineers Accessories.

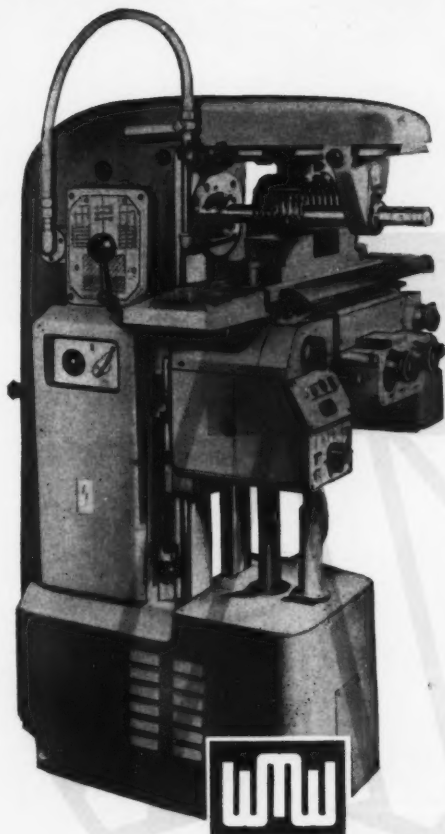
**SEND FOR FULLY  
ILLUSTRATED  
LEAFLET — TODAY !**

**T. S. HARRISON & SONS LIMITED • HECKMONDWIKE • YORKSHIRE**

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# HORIZONTAL KNEE TYPE MILLING MACHINE

## MODEL FW 160 x 630



Available styles:

- a) Changing of spindle speeds by change pulleys and with pick-off gears for feeds
- b) Change speed gear for the milling spindle drive and 18 step gearing for feeds

## VERTICAL MILLING ATTACHMENT VA 160

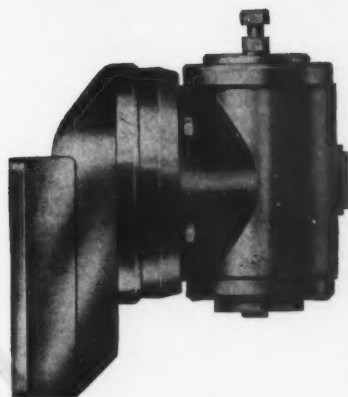


Table size

Machine taper:

Normal ISA steep taper

To option ISA steep taper

Range of milling spindle speeds

Range of feeds, normal

Automatic control of table motions

160 x 630 mm

40 mm

30 mm

45—2800 r.p.m.

5—250 mm/min.

### CONVENTIONAL MILLING

- 1 Starting of rapid traverse by press-button. Automatic change over to:
- 2 Feed to the right
- 3 Rapid reverse traverse to the left
- 4 Stop left-hand

### INTERMITTENT FEED MILLING

- 1 Starting of rapid traverse by press-button. Automatic change over to:
- 2 Feed to the right
- 3 Rapid traverse to the right
- 4 Feed to the right
- 5 Rapid reverse traverse to the left
- 6 Stop left-hand

### RECIPROCAL MILLING

- 1 Starting of rapid traverse by press-button. Automatic change over to:
- 2 Feed to the left
- 3 Rapid reverse traverse to the right
- 4 Feed to the right
- 5 Rapid reverse traverse to the left
- 6 Stop at will by press-button

Vice versa control is provided.



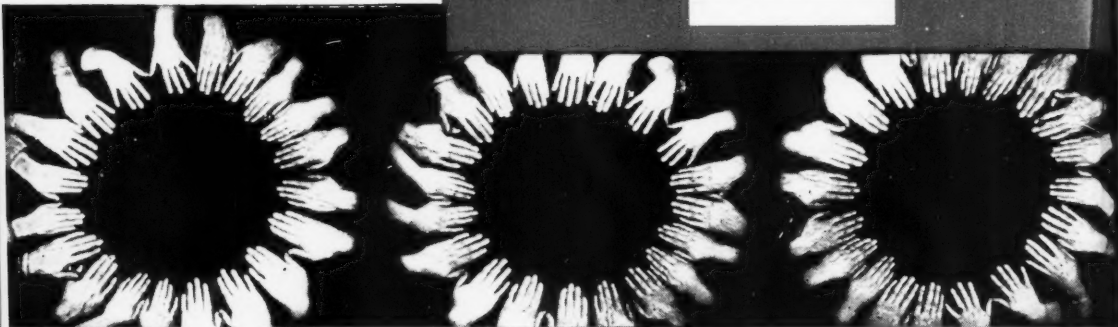
**VEB WERKZEUGMASCHINENFABRIK AUERBACH**

Exporters: **WMW-EXPORT** Außenhandelsunternehmen für Werkzeugmaschinen · Metallwaren · Werkzeuge · Berlin W 8, Mohrenstrasse 60/61  
German Democratic Republic

Representative: William Watts, Canal Street, Nottingham/England.

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## DO YOU KNOW ...



## PRODUCTION

It takes at least thirty people—thirty pairs of skilled hands—to make one DORMER Drill. Every operation is performed by experienced operators with the most up-to-date machinery. Careful heat-treatment and inspection are equally essential in maintaining the consistently high standard of DORMER Tools.

At least one in every ten people employed in the manufacture of DORMER Drills is an Inspector. Throughout production and before each DORMER Tool leaves the works, every feature is

## INSPECTION

checked in minute detail.

## PERFORMANCE

With correct use, a DORMER Drill of 1 in. Diameter, in its lifetime on general purpose work, will remove 2,800 times its own weight in material (over  $1\frac{1}{2}$  tons), and drill a total length of hole five hundred yards long!



DORMER

## TWIST DRILLS

THE FINEST BY ANY STANDARD

THE SHEFFIELD TWIST DRILL AND STEEL COMPANY LIMITED  
SHEFFIELD ENGLAND

DORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS



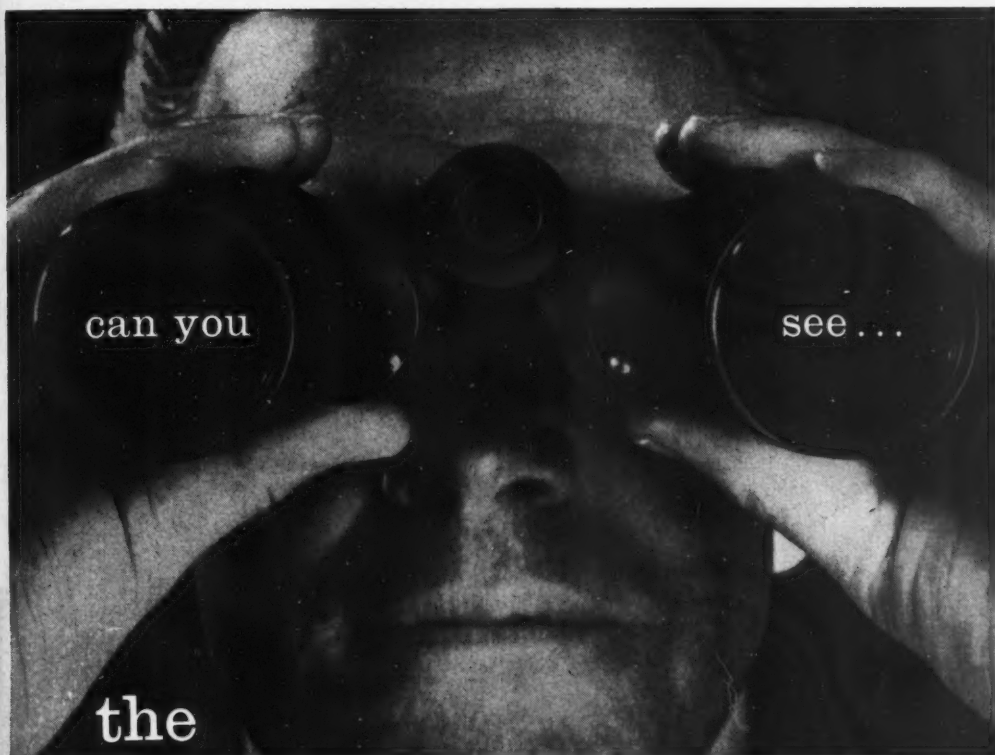
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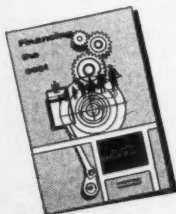
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## the way ahead?

You probably have plans—to step up production, to expand, to modernise your machinery. But carrying them out may not be so easy. Can British Wagon help? The British Wagon Finance Plan allows you to acquire new machines or plant without seriously affecting those vital capital reserves. The terms of the B.W. Plan are economical and flexible; the procedure simple. Discuss your requirements with your local British Wagon branch manager—for immediate, friendly and practical advice, backed by over 90 years' sound financial experience. . .



... or write for our leaflet 'Financing the Cost'. It gives you full details of how the British Wagon Finance Plan can help you.



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Southern Head Office: Rotherham House, Grosvenor  
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Member of the Finance Houses Association

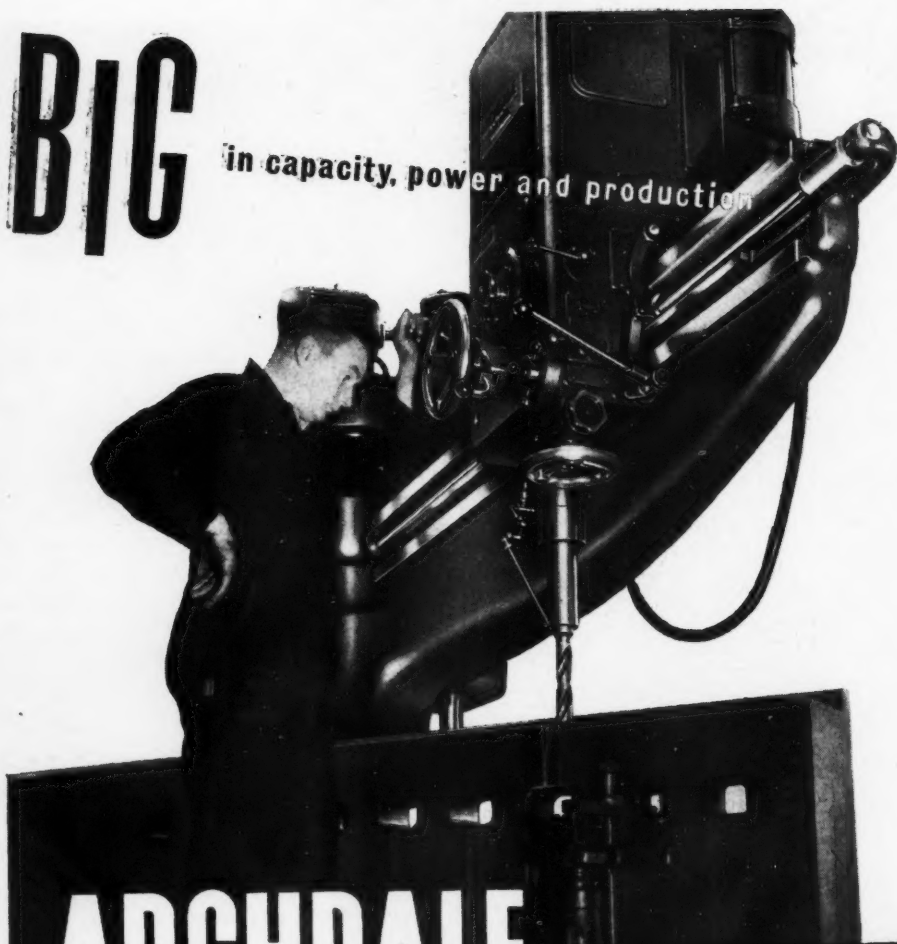


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# BIG

in capacity, power and production



# ARCHDALE

**MECHANICAL PRE-SELECT**

*Radials*

**JAMES ARCHDALE & CO., LTD.**

**BLACKPOLE WORKS : WORCESTER**

Tel: Worcester 27081 (7 lines)



Sole Selling Agents: **ALFRED HERBERT LTD, COVENTRY**

Tel: Coventry 89221

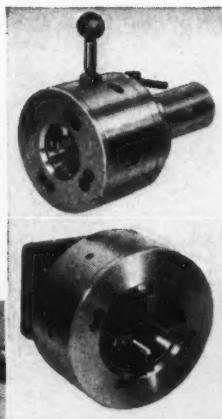
At Brookes (Oldbury) Ltd., Birmingham, this ARCHDALE radial with speeds that can be pre-selected at any time with the spindle running or stationary, ensures the fastest possible drilling rates on a wide range of work.

We show the machine drilling holes 1½" dia. by 5½" deep, in hydraulic shear bodies.

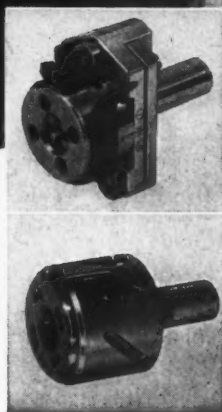
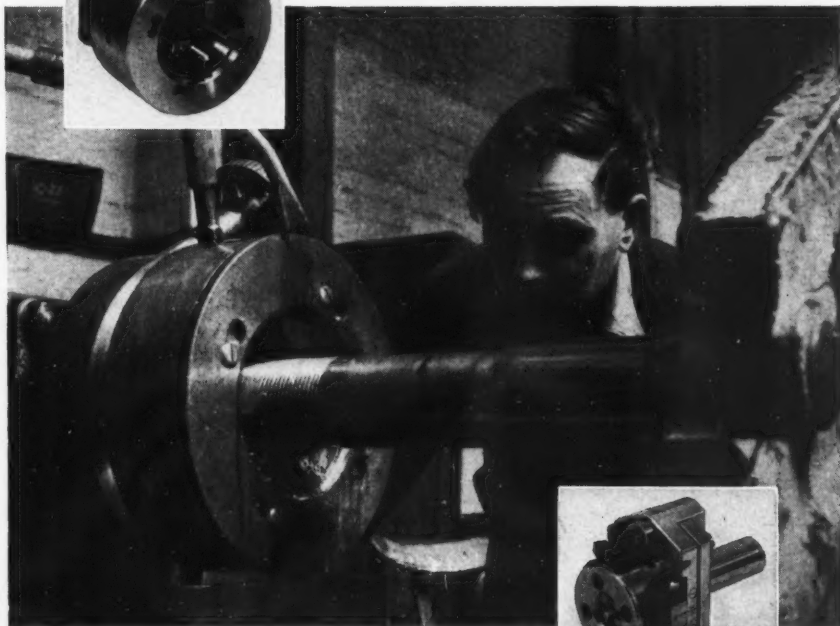
Capacity from solid-in cast iron is up to 4' dia. There are sixteen speeds, from 15 to 1500 r.p.m., and 12 rates of feeds. Sizes are from 4 ft. to 8 ft. spindle radius.

Ask us to send you details of the complete range of ARCHDALE radials and heavy duty verticals.

*When answering advertisements kindly mention **MACHINERY**.*



*the world's finest  
threading equipment —*  
**COVENTRY DIEHEADS**



A supreme range without equal; foremost in its field for nearly sixty years. Types available for rapid production; for use on spindles subject to rapid indexing; for use on stationary spindles and revolving spindles, with or without reverse; for cutting parallel or taper, short or long threads.

Self-opening Dieheads, 13 sizes,  $\frac{1}{8}$ " to 4". Rotating Self-opening Dieheads, 11 sizes,  $\frac{1}{8}$ " to 3 $\frac{1}{4}$ ". Solid Adjustable Dieheads, 8 sizes,  $\frac{1}{8}$ " to 3 $\frac{1}{4}$ ".

1500 sizes and types of dies for cutting from commercial to precision threads, from the finest to coarsest pitch, standard or special forms, in all materials that can be threaded.

ALFRED

**HERBERT**

LTD., COVENTRY



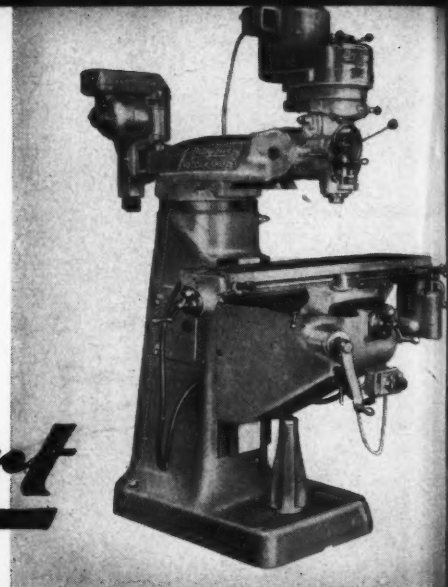
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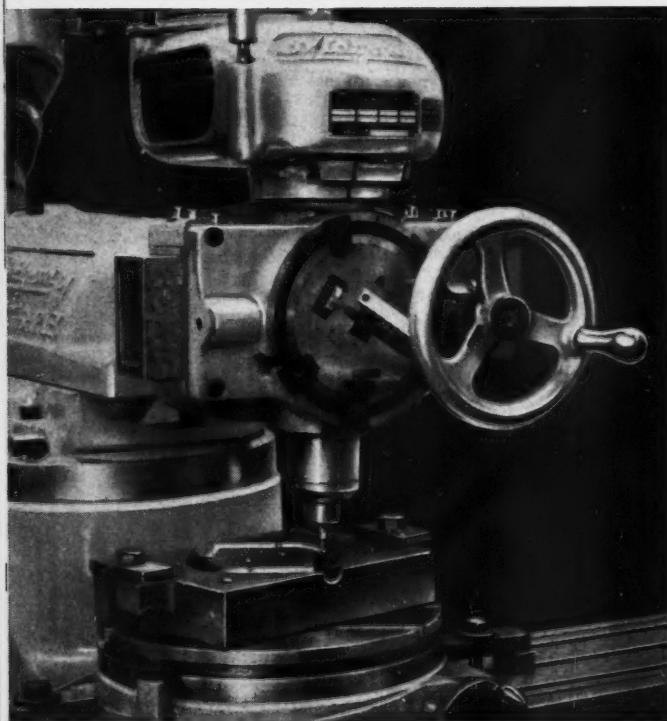


- ★ The range of equipment available makes its use almost unlimited.
- ★ You can buy extra Bridgeport attachments out of the profits the basic machine earns.
- ★ Almost every machine shop in the U.S. has at least one Bridgeport: yet demand has exceeded supply for twenty years.
- ★ The genuine Bridgeport is now also made in Britain—with the most efficient large-scale production techniques. So the price is incredibly low . . . and demand is—naturally—high. Delivery is 'first come, first served'—so get your order off now!

# ***Bridgeport***



*-the miller that is more universal than any 'universal'*



## 5

of a series showing applications of this versatile machine  
Semi-circular shapes produced easily by cherrying attachment.

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only the  
**Bridgeport**  
offers so much

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# A & S

**ADCOCK & SHIPLEY LIMITED**

P.O. Box 22, Ash Street, Leicester.

Telephone: Leicester 24154, 5

... for cutting spur gears and splines in shafts and slots down to .014" wide, in trick cylinders the ...

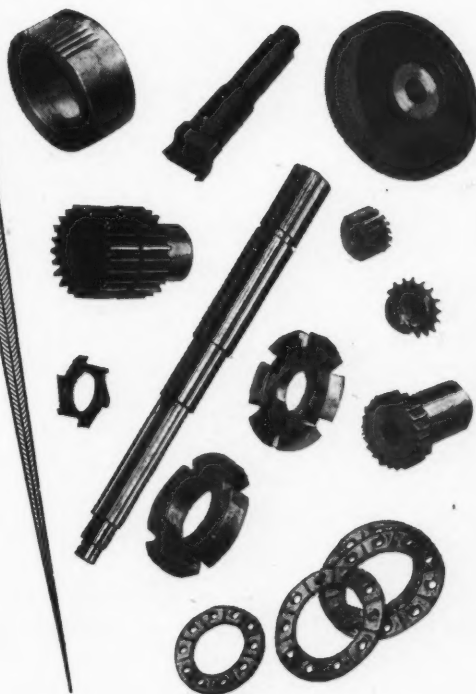


## GEAR & SPLINE CUTTING MACHINE

- ★ **POWERFUL DRIVE**
- ★ **EXTREMELY RIGID AND DURABLE**
- ★ **ACCURATE INDEXING MECHANISM**

Available in both Plain and Universal form, the latter having a swivelling cutter slide enabling spur or bevel gears to be cut and other angular work index milled.

Capacities	Plain	Universal
Max. diameter	36"	24"
Max. stroke of cutter slide	8"	4½"
Max. pitch, Cast Iron	5 D.P.	5 D.P.
" " Steel	6 D.P.	6 D.P.



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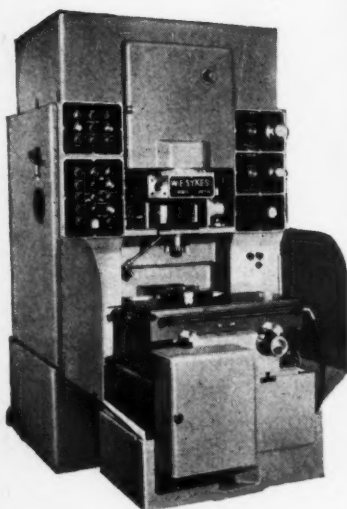
## Talk to Sykes about the V10B Vertical Gear Generators



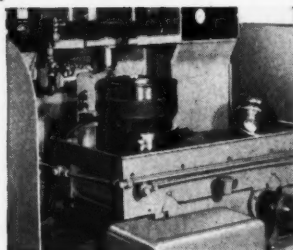
Whether you produce gears singly or in thousands there is a V10B Model designed specifically with your problems in mind. Incorporating many unique features for easy setting, simple maintenance and faster production times the V10B range of machines is years in advance of all other gear shapers.

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SPROCKETS · RACKS · SEGMENTS

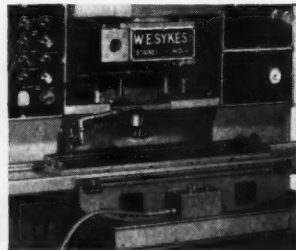
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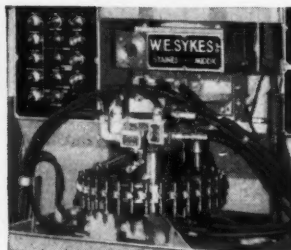
STANDARD



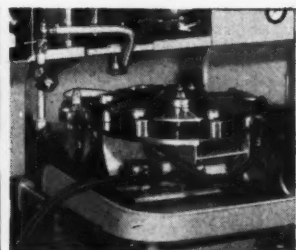
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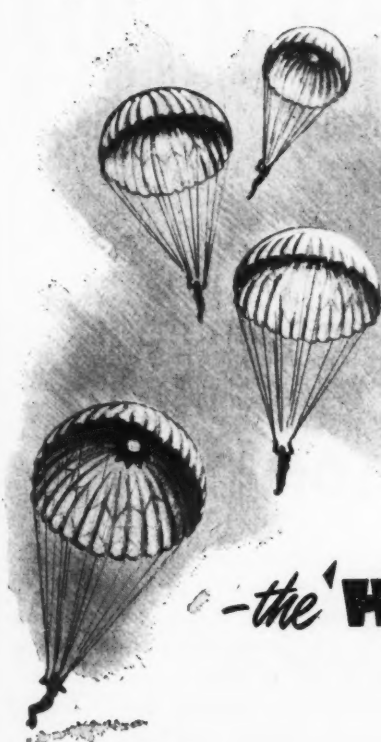
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*and associated companies:*

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# DOWN TO EARTH



Simple, practical designing  
with economy firmly in mind  
has produced a sturdy reliable  
dressing fixture at a price within  
the means of the smallest toolroom

## -the' **HABIT' TENNER**

MALE AND FEMALE RADIUS DRESSING FIXTURE

**CAPACITY** **TEN/TWENTY**  
0 — 3in. Female } radii on  
0 — 3in. Male } wheels up to  
8in. dia.

**TEN/FIFTY**  
0 — 3in. Female } radii on  
0 — 3in. Male } wheels up to  
12in. dia.

**OPERATION** By direct motion from handwheel check  
stops at 90° and 180°.

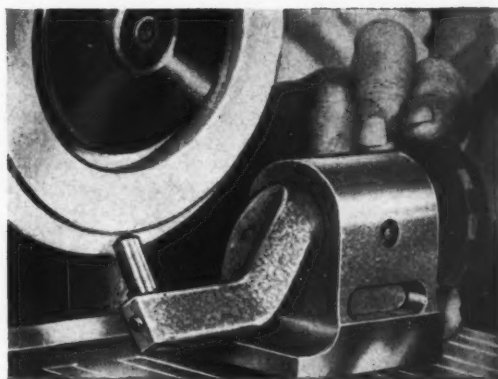
**SETTING** By gauge blocks, height gauge or  
micrometer.

**FITTING** Can be held by magnetic chuck, vice or  
clamping to bed directly

**PRICE EX WORKS LONDON**

**TEN/TWENTY £12 TEN/FIFTY £15**

Postage, container and packing inland 5/-.  
Suitable diamond Tool 50/-.



*illustrated literature on request*

## **HABIT DIAMOND TOOLING LTD**

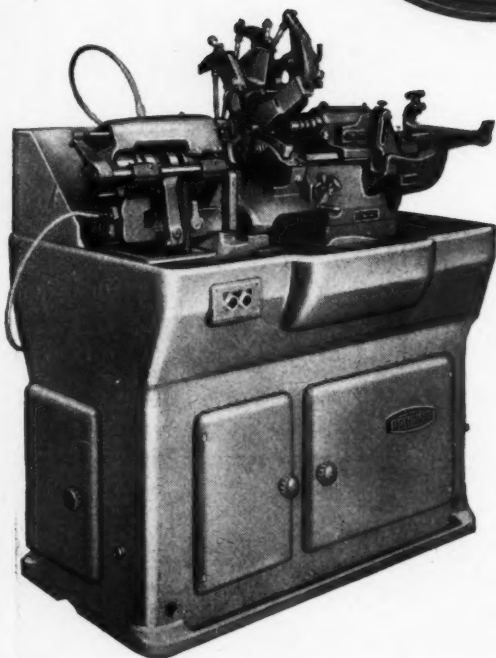
HABIT DIAMOND TOOLING LTD LURGAN AVE., LONDON W.6 Tel.: FULHAM 7944

**For RAPID Production of...**

# LONG SLENDER WORK



License BÉCHET,  
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## Single Spindle SLIDING HEAD AUTOMATIC

Work is supported close to the radial tools ensuring maximum accuracy on long slender parts. Second operations eliminated, both ends being completed at the one operation. Radial tools provided with micrometer setting. Sturdy built-in 3-spindle drilling and tapping slide gives maximum threading capacity. Camshaft readily accessible for setting. Wide range of camshaft speeds provided and accelerator reduces idle time.

Built by  
Parker Engineering Services Ltd.  
for the  
Sole British Licensees:

Bar capacity  $\frac{1}{2}$ ". Turning length 4". Spindle speeds (20) 570 to 5700 r.p.m. Tapping: .393" dia.—.040" pitch (mild steel) .472" dia.—.070" pitch (brass). Also available in  $\frac{3}{4}$ " capacity.

Write for illustrated brochure M/225



### DOWDING & DOLL LTD

346 KENSINGTON HIGH STREET, LONDON, W.14

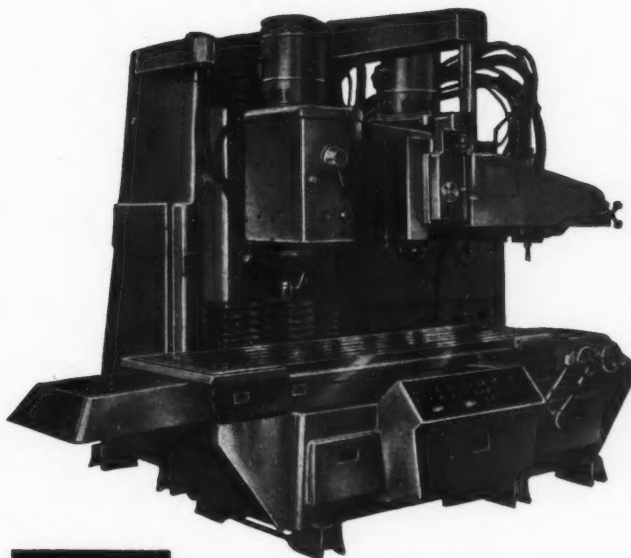
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# Copies Left- and Right-hand die halves simultaneously



SWISS

**RIGID**

## AUTOMATIC HYDROCOPYING DIE SINKER MODEL KAB 250

Fully automatic — roughing and finishing — this exceedingly robust bed-type machine copies 3-dimensional dies, without supervision, from wooden or plaster models. Both left- and right-hand halves of the die can be copied at the same time from the same master. 360° profiling can be performed at constant feed, without rotating circular tables, and on vertical contours. Servo hand control permits speedy roughing. The machine has two spindles; single- and 4-spindle machines are available also.

*Table size 130" × 25½". Spindle speeds (18) 42 to 2000 r.p.m.  
Copying feeds, steplessly variable .4" to 15.75". Pick feeds .006" to .2".*

Send for fully illustrated brochure M/188.

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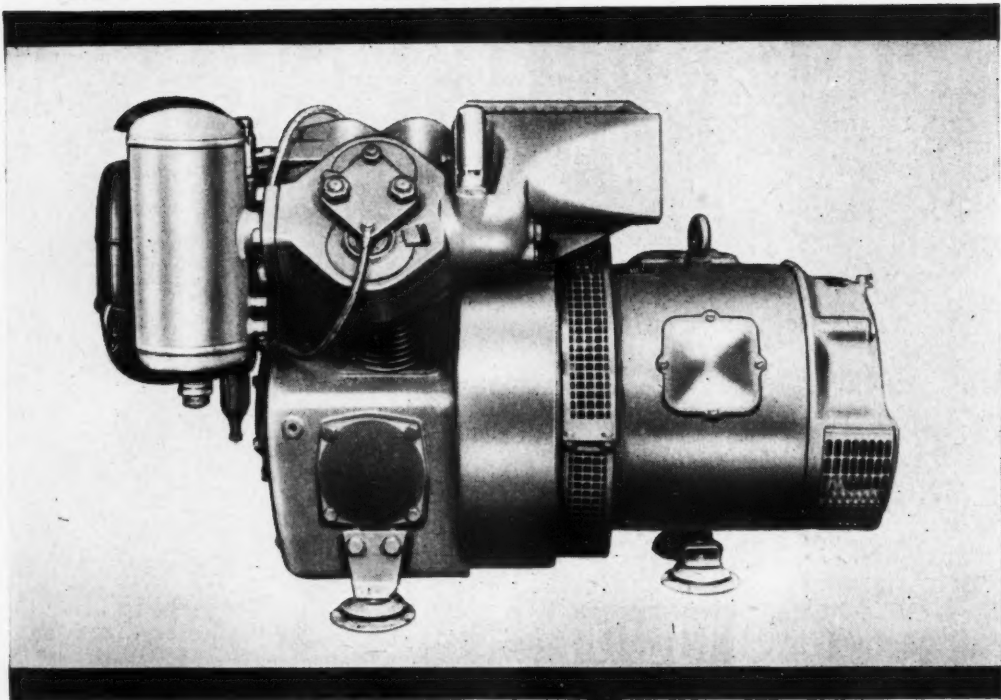
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## HERE'S AIR POWER FOR THE MEDIUM SIZED WORKSHOP



### THE ATLAS COPCO COMPRESSOR TT6

Developed from the famous VT portable compressors, the Atlas Copco TT6 is a compact, heavy-duty machine for round-the-clock operation where there is a moderate but continuous demand for compressed air.

The compressor is a single-acting, two-stage machine with air-cooled cylinders and intercooler. It is built for a normal working pressure of 100 p.s.i. and has a free air delivery of 141 c.f.m.

**NO FOUNDATIONS NEEDED.** The TT6 and its electric drive motor are mounted on 'Metalastik' bonded rubber feet. This eliminates the need for foundations as the compressor can be placed directly onto concrete floors. The TT6 can also be moved from place to place as circumstances dictate.

Like the VT portables, the TT6 combines an outstanding power/weight ratio with a basically simple design which ensures reliable service and easy maintenance. The TT6 is a sound investment for medium-sized or small-but-growing companies.

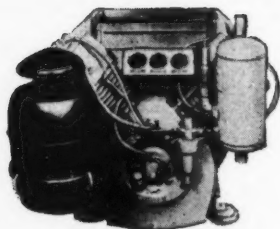
**AUTOMATIC CONTROL AVAILABLE.** Available as an optional extra, the Atlas Copco Regulator allows the TT6 to be run with standard valve unloading system or as a fully automatic stop-and-start unit.

**WRITE FOR THE LEAFLET** Atlas Copco leaflet E1207-1 gives full details of the TT6. It is freely available on request from the address shown.

#### ATLAS COPCO (GREAT BRITAIN) LIMITED

Maylands Avenue, Hemel Hempstead, Herts. Tel: Boxmoor 6040

Sales and Service Depots: LONDON · BRISTOL · CARDIFF · LICHFIELD  
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1/204

## *Atlas Copco*

puts compressed air  
to work for the world

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There are over 50 years  
experience  
behind...



## ...ROWBOTTOM cam milling machines

*Hydraulic Tracing Units available.*

Rowbottom N.325 cam miller with Timken mounted cutter spindle has 8 speeds (80 - 600 r.p.m.)

The workhead is adapted to either barrel or face or box cams by rotating on trunnions to bring the axis of the work spindle either in a vertical or horizontal position.

Box and face cams up to 32" diameter, barrel cams up to 30" diameter; stroke or throw of cams up to 12". Larger sizes can be handled with special modifications.

*\* Rowbottom for CAMS since 1902*

**GASTON E. MARBAIX LTD.**

Send for  
Bulletin No. M.58

DEVONSHIRE HOUSE, VICARAGE CRESCENT, BATTERSEA, LONDON, S.W.11 Phone: BAttersea 8888 (8 lines)



## Cold Headed Bolts and Set Screws

Why look elsewhere, when all the benefits of long specialization plus the closest adherence to exacting quality standards are so conveniently available. Let

ORMOND quote for all Repetition Parts—for single and multi spindle automatics up to 1½" diameter; Brass,

Steel and Light Alloy Screws in Rolled and Cut Threads, Grub screws, Nuts, Allthreads, Hexagon

Bolts and Set screws turned from bar and Cold Headed Grades "A", "B" and High Tensile.



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## Facing Copy Lathes

MODELS

KH 45

and 55



With the UNICOP electronic-hydraulic two co-ordinate copying system for machining deep and difficult profiles.

The headstock and carriage are mounted on a common bed with two vee-slides on which both can be traversed.

A single button on the pendant control panel sets the machine for use as a normal facing lathe without copying.

Available with infinitely variable spindle speeds and constant cutting speed control: Maximum turning diameter up to 55 inches.

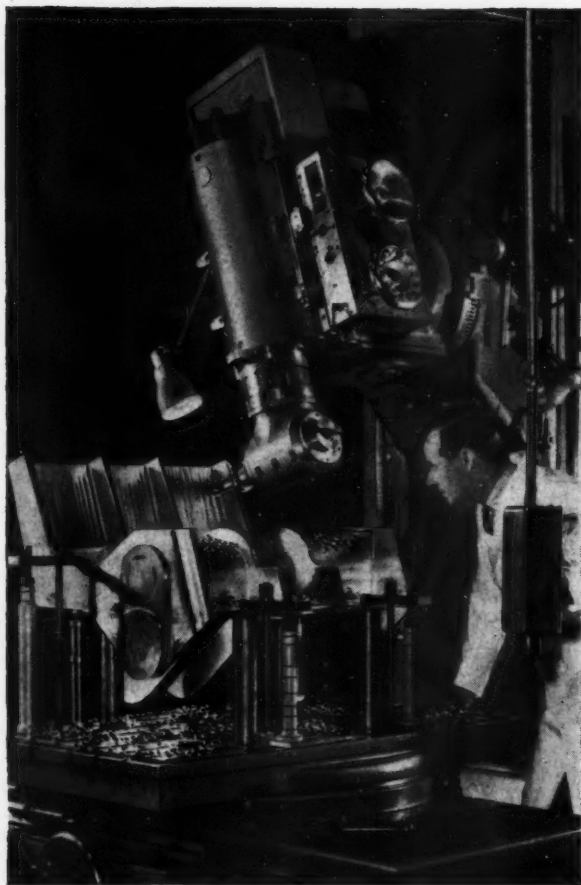
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# SYKES MACHINE TOOL COMPANY LIMITED

Hythe Works, The Hythe, Staines, Middlesex. Telephone Staines 55474 (5 lines) Telegrams Sytool Staines

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The Clare System of Milling Equipment being used on this large universal boring and milling machine at the Surrey works of Morfax Ltd., demonstrates the "machining" results which can be achieved with Clare. The special aircraft component, high tensile light alloy, is machined from the solid and on the application illustrated a spiral 2-flute cutter is being used. The "finished" components are held to extremely close tolerances.

*Write for Comprehensive Milling Equipment Handbook*

## CLARE COLLETS LIMITED

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# CLARE



**gets its teeth  
into the job**




**ALL**
**THESE INTERNAL FORMS  
ARE EASY WITH A...**
**FROMAG**

## KEYSEATER

There is a FROMAG Keyseater to suit your requirements whether keyways are from  $\frac{1}{4}$ " to 10" wide, up to 98" in length, bores from  $\frac{1}{2}$ " to 59" diameter can be handled.

This range of machines are economic units whether for mass production, small batch quantities or single parts, where high accuracy, efficiency and speed are a necessity. They can handle small pinions with  $\frac{1}{2}$ " bore to ships' propellers with 5' bores weighing 30 tons.

Model KZ.50 for keyways from  $\frac{1}{4}$ " to  $1\frac{1}{4}$ " in width and up to 17 $\frac{1}{2}$ " length.



Even 25% utilisation makes the FROMAG Machines an economic proposition. A combined tilting and floating table can be supplied for cutting keyways in cylindrical bores and for keywaying taper bores. The larger machines can also be used as vertical broaching machines, 6-ton capacity.

# MORTIMER

**EXCLUSIVE**
**DISTRIBUTORS OF THE FINEST MACHINE TOOLS**

MORTIMER MACHINE TOOL CO. LTD · MORTIMER HOUSE · ACTON LANE · LONDON NW10 · Tel: ELGer 3834-5-6



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# OLIN MATHIESON LIMITED\*

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**Manufacturers and Suppliers of the Armstrong Airbreaker System on Coal Mining, have available for immediate use the following services at their Perivale, Middlesex, factory.**

1. Hydraulic Pressure Testing to 30,000 lbs. per sq. in.
2. Pneumatic Pressure Testing to 12,000 lbs. per sq. in.
3. Hardness Testing by either Brinell or Rockwell Systems.
4. Material analysis and certification.
5. Press Capacity.

***Please address all enquiries to :***

**CHIEF ENGINEER,  
6 WADSWORTH ROAD,  
PERIVALE, GREENFORD,  
MIDDLESEX.**

**Telephone: Alperton 2241 (7 lines)**

**\* SUBSIDIARY OF OLIN MATHIESON CHEMICAL CORP U.S.A.**

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, 1961

**D\***

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# Sheets from the Coil

**-Accurate  
-Any length - Flat**

**McKAYMATIC  
Die Shear Lines**



**McKAY  
MACHINE**

**BRITISH BUILT BY VICKERS**

McKAYMATIC DIE SHEAR LINES uncoil, level and cut to any length upwards of 9" in a continuous operation. Cutting is effected by a flying shear synchronized with the material speed, precluding any strip damage. Sheet lengths and quantities are push button preselected, stopping the line being unnecessary when changing length.

Punched cards enable automatic programming for different quantities of varying lengths. Very compact design with no pit—overall length of basic 48" line including coil holder is only 21 feet. Save by using coiled material which is cheaper than sheet. Remember, special lengths do not involve extra cost and waste is reduced to the minimum.

**INDISPENSABLE FOR STOCKHOLDERS AND LARGE USERS**

**ROCKWELL**  
MACHINE TOOL CO. LTD.

*For further particulars write or telephone TODAY*

**WELSH HARP, EDGWARE RD., LONDON, N.W.2. TEL: GLADSTONE 0033**

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# Grind to less than *.00005!*

with the

## TAFT-PEIRCE

### NO. 1 GAUGE GRINDER

Take a side wheel grinding set up. Grind to a zero reading on the cross feed dial.

Move the work away one or two thousandths with the cross feed vernier then return to its original position.

**THERE IS NO GRINDING SPARK.**

Now feed in *.00005"* with the vernier  
**AND SEE THE SPARK.**



#### TILTING WHEELHEAD

Quill mounting block can be tilted up to 30° above horizontal in up to 30° dovetail slides. This enables many jobs to be ground with the angular face or periphery of the wheel rather than the side, giving a better finish and saving time and wheel wear in dressing.

- Table, saddle and column travel on hardened and ground ball tracks or roller ways.
- All traverse ways replaceable—prolonged machine life.
- Hardened and ground cross feed screw, automatically adjusting anti-backlash nut.
- Ball-bearing quill-type spindle with direct drive by 3000 r.p.m. motor.
- One shot lubrication system.
- Vernier fine feeds calibrated in 0.0001" with graduations  $\frac{1}{2}$ " apart available on cross and vertical movements.

#### BRIEF SPECIFICATION

Table working surface	12" x 5"
Height under wheel	12"
Spindle motor	3/4 h.p.
Grinding wheel	7" x $\frac{1}{2}$ " x $1\frac{1}{4}$ " bore
Net weight	13½ cwt.

**ROCKWELL**  
MACHINE TOOL CO. LTD.

*For further particulars write or telephone TODAY*

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## UNIVERSAL BROACH SHARPENING MACHINES



A COVENTRY GAUGE & TOOL CO. PRODUCT

- For all types of circular, flat and spiral broaches up to 72 in. long.
- 12 in. cross travel of wheelhead accommodates wide flat broaches.
- Wheelhead swivels for grinding shear cut broaches.
- Four speed workhead incorporates indexing for 2, 4 and 6 divisions.
- Tailstock centre height adjustable for tapered broaches.
- All controls conveniently placed for easy operation.

### Two Models

- WITH MANUAL CROSS MOVEMENT OF WHEELHEAD or
- WITH HYDRAULIC CROSS MOVEMENT OF WHEELHEAD (as illustrated)

#### BRIEF SPECIFICATION

Capacity between centres	... ..	72"
Height of centres	... ..	6½"
Cross travel of wheel head	... ..	12"
Grinding wheel speeds.	... ..	2800 & 5600 r.p.m.
Workhead speeds.	... ..	130, 180, 230 and 320 r.p.m.

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Matrix 8

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## ***PRECISION FILING & SAWING MACHINE***

A TYPICAL EXAMPLE OF  
WORK PRODUCED



**Hardened Tool Steel**

**139 mins.**

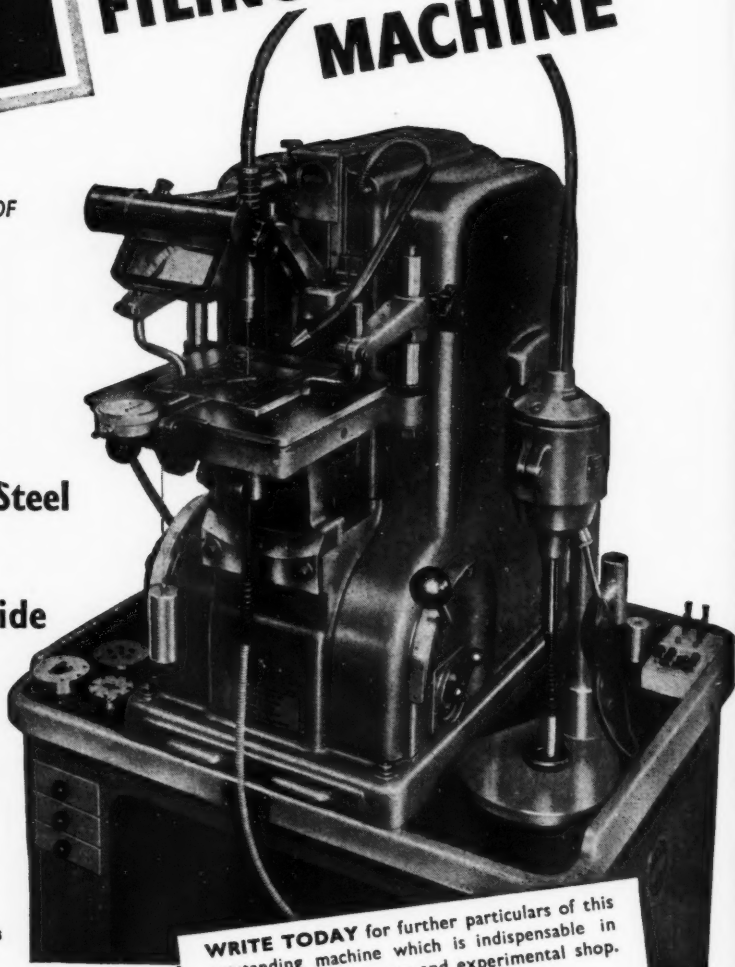
**Tungsten Carbide**

**310 mins.**

This is the only  
machine on which  
such speeds and  
precision are possible

*Ask for detailed  
quotation*

Swiss Type Machine Files  
**EX STOCK.**



**WRITE TODAY** for further particulars of this  
outstanding machine which is indispensable in  
every modern toolroom and experimental shop.  
Inspect this machine in our showroom.

**ROCKWELL**  
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2022





*"Maybe you  
could express it  
a little better . . ."*

*"Well, a chuck is just a  
chuck unless it is a chuck made  
by Jacobs when it is a genuine  
Jacobs chuck the best known  
name in chucks!"*

*"Your dealer can supply  
genuine Jacobs chucks  
in all sizes for light medium  
or heavy duty tools and  
machines"*

**INSIST  
ON  
GENUINE**

**Jacobs**

**CHUCKS**

THE JACOBS MANUFACTURING CO. LTD., ARCHER ROAD, SHEFFIELD, 8

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## The finest tools of their kind

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FOR GENERAL WORK

### SERIES 100 H/COP



FOR COPYING AND  
PRODUCTION LATHES

### SERIES 100 A



WITH INTERCHANGEABLE  
INSERTS

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SHOCK RESISTING

### SERIES 170



FOR PIPES AND  
HOLLOW COMPONENTS

### SERIES 200 S



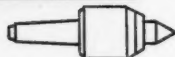
FOR REALLY HIGH  
SPEED WORK

### SERIES 250



FOR EXCEPTIONALLY  
HEAVY DUTY

### SERIES 300 D



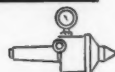
FOR HIGH AXIAL LOADS

### SERIES 400



FOR HEAVY  
CONTINUOUS LOADS

### SERIES 600

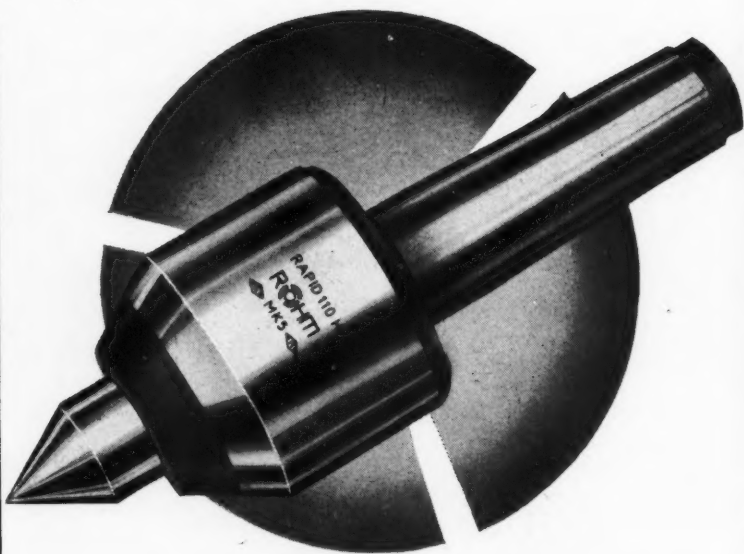


FOR MEASURING,  
SETTING & MANUAL  
CONTROL OF AXIAL PRESSURE

### SERIES 600 A.C.



FOR AUTOMATIC HYDRAULIC  
COMPENSATION FOR LENGTH



# ROHM

## REVOLVING CENTRES

\* a type and size for *EVERY* duty

Whatever your requirements in revolving centres there is a type and size in the ROHM range exactly to meet your needs. Each and every type has been specifically designed to ensure the highest possible performance. Ask for further details.



**MICHAEL S. THOMPSON LIMITED**

185 Hammersmith Road, London, W.6, England  
TEL: RIVerside 7922/3 GRAMS: Tomtool, London, W.6

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# Toolroom Precision-*Plus Production Speeds*



## fmi 2000 HORIZONTAL BORING MACHINE

Hydraulic feed to table and head.

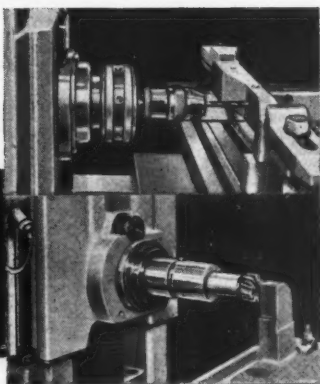
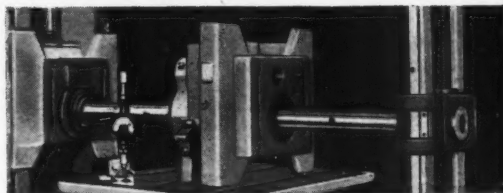
Spindle diameter  $3\frac{5}{8}$ ".

Table 18" x 24".

Spindle speeds (18) 22 - 1,150 r.p.m.

Maximum height of spindle to table 16".

Distance between spindle and boring stay 41".



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EXCLUSIVE DISTRIBUTORS IN THE UNITED KINGDOM.

### MACHINE TOOL COMPANY LIMITED

172-178 VICTORIA ROAD, ACTON · LONDON W3 · Telephone ACORN 5555  
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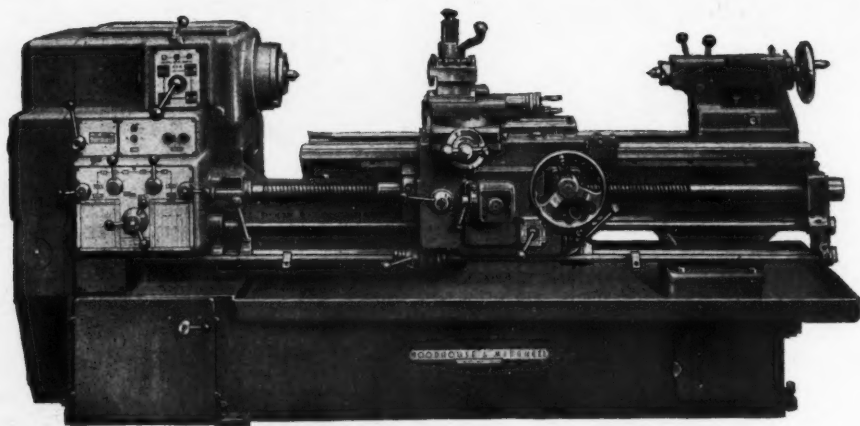
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D2

# THE **w m** RANGE

The range of machines produced by Woodhouse & Mitchell includes centre lathes and turret millers. Three of the latest designs are illustrated here : built to modern specifications, they are being used with complete satisfaction by discriminating engineers.

**w m w m w m w m**



**'85' 8½" and 10½" Centre Lathes**

8½ in. size : 10 h.p. motor, 12 speeds  
21-945 r.p.m.

10½ in. size : 12 speeds  
14-630 r.p.m.

alternative, 21-945 r.p.m.

## WOODHOUSE & MITCHELL

*When answering advertisements kindly mention MACHINERY.*





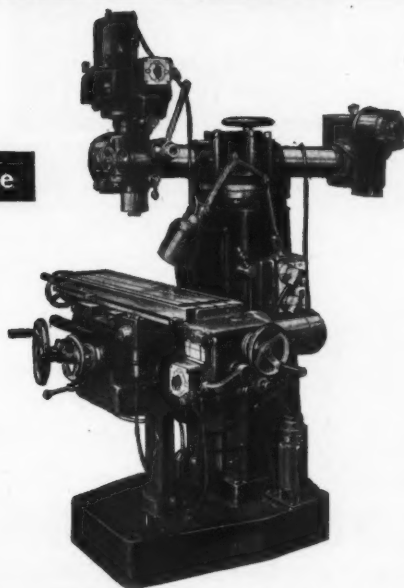
**'70' Junior 7" Centre Lathe**

2 h.p. motor; 8 speeds, 30-437 r.p.m. also alternative 44-640 r.p.m., and (when fitted 2-speed motor) 30-874 r.p.m. and alternatively 40-1200 r.p.m. Sizes are made to admit 45in., 54in. and 72in. between centres.



**369 Turret Milling Machine**

For milling, boring and jig-boring at any angle, key-way and end milling, die-sinking, mould and pattern-making. Table 36in. by 9in., 10 spindle speeds 100-2000 r.p.m. (alternative 200-4000 r.p.m.)



**WAKEFIELD ROAD • BRIGHOUSE • YORKS**

PHONE: BRIGHOUSE 627 (3 LINES) — GRAMS: 'WOODHOUSE BRIGHOUSE'

WM33

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# SANDERSON'S STEELS

Alloy  
Cold  
Work  
Steels

High  
Speed  
Steels

Alloy Shock Resisting Steels

Alloy Hot -  
Work Steels

Carbon  
Tool  
Steels

Publications giving details of the full range, analysis, heat treatment etc. of Sanderson's high grade steels, are readily available on request.

Our services are also freely at the disposal of customers who require advice on the selection and manipulation of steels.

Write to

## SANDERSON BROTHERS AND NEWBOULD LIMITED

Makers of Tool Steels, Saws for Wood and Metal, Machine Knives  
Heliocentric Speed Reducing Gears, Engineers Cutting Tools

Attercliffe  
Steelworks,  
P.O. Box 6.,  
Newhall  
Road,  
Sheffield 9.  
Est. 1776

# for maximum production



the **SMART & BROWN**

SERIES

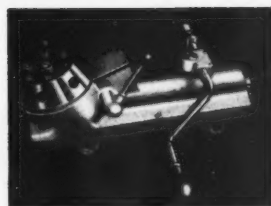


**CAPSTAN LATHE**

Maximum dead length collet capacity	11/16"
Centre height ... ..	4"
Spindle bore to turret face (max.)	1 1/4"
Spindle nose ... ..	29/32"

**EPICYCLIC GEARBOX** available

**ONE OF BRITAIN'S FINE LATHES**



*LRST turret slide*



*CWP screw operated cut-off slide*



**Smart & Brown (machine tools) Ltd.**

25 MANCHESTER SQUARE · LONDON · W.1

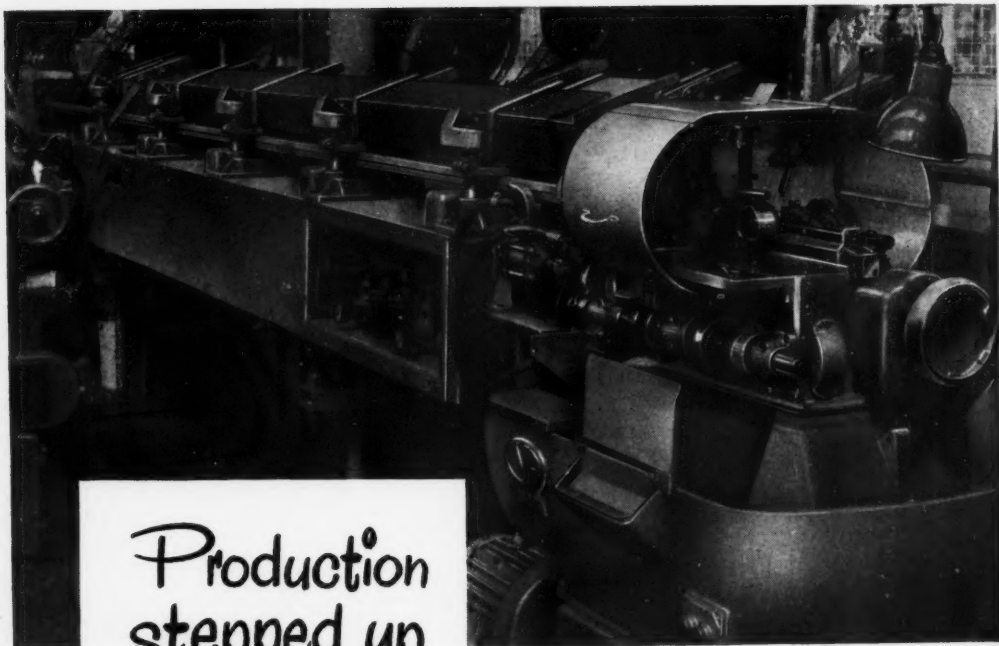
Telephone: WELbeck 7941-5 Cables: Smartool, Wesdo, London.

MAKERS OF PULTRA MICRO LATHES AND GRINDING MACHINES

Member of the GAS PURIFICATION AND CHEMICAL GROUP OF COMPANIES

NRP3583

*When answering advertisements kindly mention **MACHINERY**.*



Production  
stepped up  
30% to 100%

BY ELIMINATING IDLE TIME

**LIPE**

FULLY AUTOMATIC  
PNEUMATIC BAR FEED

cuts costs on auto  
screw machines  
— NEW or OLD

The LIPE Bar Feed scores its great advantage by reducing idle machine time. After installing the LIPE system you have no need to stop the machine for loading fresh bar stock or locating the bar end for the first part-off, the entire bar stock being fed automatically from the magazine right down to the last workpiece length. When the portion of bar stock remaining in the collet is insufficient for the next component the automatic disengagement of a clutch stops the tool cycle with spindle running and collet open ready for the new stock bar to eject the remnant and continue the cycle. New stock is fed out to a predetermined length so as to restrict stock wastage to a minimum. There are no awkward control trips to set—you'll find that LIPE Bar Feeds make your automatics really automatic!

Write for full details to Dept. M/12.  
PATENTS Nos. 728898, 743461 AND 827417.



*Automation Ltd.*

DEVONSHIRE HOUSE VICARAGE CRESCENT, LONDON, S.W.11. PHONE BATTERSEA 5541

NRP 12

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, 1961



NRP 12





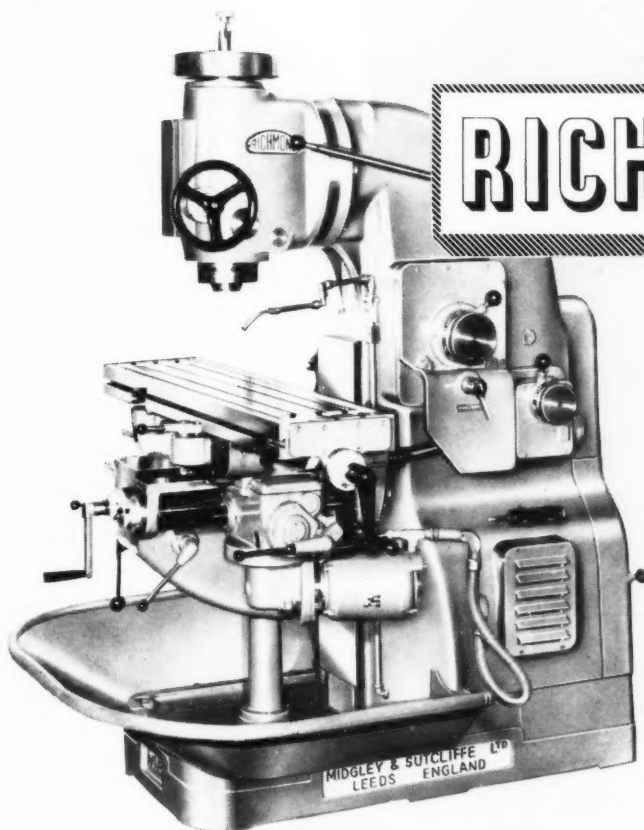
**GREATER POWER &  
GREATER WEIGHT**

*with the*

**RICHMOND**

**Nº 3**

**VERTICAL  
MILLING  
MACHINE**

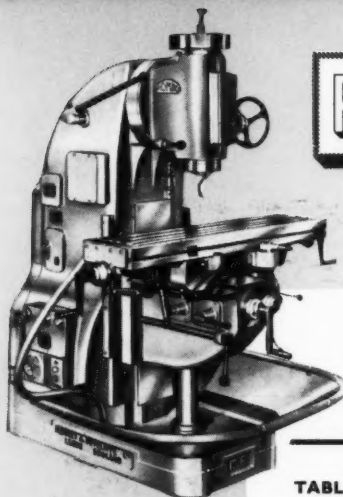


*stocked by  
Leading Machine Tool Merchants  
throughout the country*

THE  
**600**  
GROUP  
OF COMPANIES  
Registered in Great Britain

**MIDGLEY & SUTCLIFFE LTD**  
HILLIDGE WORKS · HUNSLET · LEEDS · 10

Telephone: 76932 3    Telegrams: 'Tools', Leeds, England



# RICHMOND

# Nº 3

## VERTICAL MILLING MACHINE

### SPECIFICATION

TABLE		ENGLISH	METRIC
		48" × 11" 3" × 3/4" 24"	1219 mm. × 279 mm. 76 mm. × 14 mm. 63 mm.
FEED RANGE	Longitudinal Power Feed ..	30"	762 mm.
	Cross Power Feed .. .. .	8"	203 mm.
	Vertical Power Feed .. .. .	16"	406 mm.
SPINDLE HEAD	Spindle: Nickel chrome steel hardened and ground .. .. .		
	No. 40 National Standard taper, 3 1/4" per foot ..	YES	YES
	Diameter of nose .. .. .	3 1/4"	89 mm.
	Size of hole through (1/2" drawbolt) ..	21/32"	17 mm.
	Head Swivels Left of Right ..	45°	45°
	Spindle adjustment (vertical) ..	3"	76 mm.
	Spindle nose to table .. .. .	16" (max.) 0" min.	406 mm. (max.) 0 mm. min.
SPEEDS	Number .. .. .	12	12
	Standard Range in geometrical progression ..	30 to 1,400 r.p.m.	30 to 1,400 r.p.m.
	Alternative Range .. .. .	20 to 1,000 r.p.m.	20 to 1,000 r.p.m.
	Spindle reverse mechanical ..	YES	YES
FEEDS	Number .. .. .	12	12
	Range—Longitudinal and cross Vertical (one half longitudinal) ..	.45" to 12.5" per min. .22" to 6.25"/min.	11.5 mm. to 317.5 mm. 5.75 mm. to 158.7 mm.
	Alternative Range—Longitudinal and cross ..	.9" to 25"/min.	23 mm. to 635 mm.
	Alternative Range—Vertical ..	.45" to 12.5"/min.	11.5 mm. to 317.5 mm.
RAPID TRAVERSE	Longitudinal and cross .. .. .	100 per min.	2540 mm. per min.
	Vertical .. .. .	50 per min.	1270 mm. per min.
DRIVE	Silent multiple V-belt from motor ..		
	Pulley Speed .. .. .	600 r.p.m.	600 r.p.m.
	Motor Speed .. .. .	1450 r.p.m.	1450 r.p.m.
	Horse Power .. .. .	7 1/2	7 1/2
SPACE	Floor space occupied .. .. .	62" × 97"	1514 mm. × 2464 mm.
SHIPPING SPECIFICATION	Approximate Net Weight .. .. .	40 cwts.	2064 Kgms.
	Approximate Gross .. .. .	46 cwts.	2330 Kgms.
	Approximate size of case .. .. .	72" × 70" × 80"	1828 × 1778 × 2032 mm.

We reserve the right to improve or modify the design and construction of these machines and attachments or any part thereof as we may see fit without incurring any obligation on machines or parts previously sold.

## MIDGLEY & SUTCLIFFE LTD

HILLIDGE WORKS · HUNSLET · LEEDS · 10

Telephone: 76932/3    Telegrams: 'Tools', Leeds, England



TRIC

× 279 mm.  
× 14 mm.  
mm.

mm.  
mm.  
mm.

YES  
mm.  
mm.

mm.  
(max.) 0 mm.  
n.

400 r.p.m.  
000 r.p.m.  
YES

to 317.5 mm.  
to 158.7 mm.

to 635 mm.  
to 317.5 mm.

n. per min.  
n. per min.

0 r.p.m.  
0 r.p.m.  
7½

× 2464 mm.

Kgms.  
Kgms.  
8 × 2032mm.

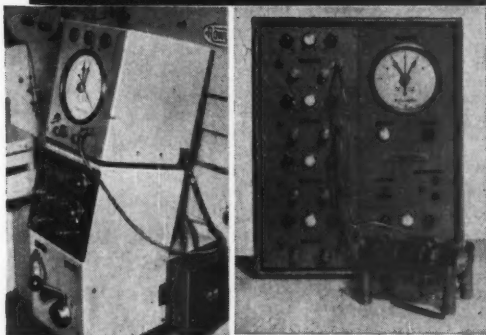
machines and  
on machines



Whatever  
your  
gauging  
problems

**Teddington**

have the  
answer



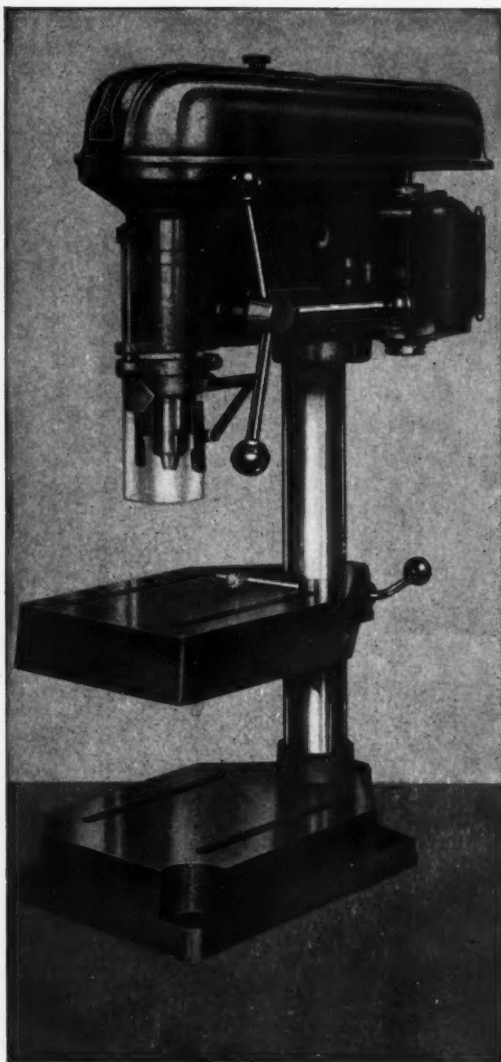
**TEDDINGTON INDUSTRIAL EQUIPMENT LTD • SUNBURY-ON-THAMES • MIDDX**

TEL: SUNBURY-ON-THAMES 600 GRAMS & CABLES: TEDDEQUIP, SUNBURY-ON-THAMES TELEX: 2-2742 TEDDCONTSNBURY

TIE96

THE  
600  
GROUP  
COMPANIES

When answering advertisements kindly mention **MACHINERY**.



# INCOMPARABLE

---

## IN PRICE & QUALITY

- Weight 154 lbs. 70 kgs.
- Five Spindle Speeds
- Throat Depth  $7\frac{5}{8}$ " : 194 mm
- Column Diameter  $2\frac{3}{4}$ " : 70 mm
- Quill Diameter 2" : 50.8 mm
- Robust Spindle and Quill Assembly with splined spindle and driving sleeve
- Large working surface to table and base
- Adjustable Depth Stop and Spring-controlled Spindle return

Supplied complete with 0-hin. Chuck, 3 phase motor, rotary on/off starter. Pedestal model £2.15.0 Extra. Single phase electrics £2.10.0 Extra.

# £42



**W. J. MEDDINGS LTD**

IPSWICH ROAD, TRADING ESTATE, SLOUGH, BUCKS.

Telephone: Slough 26761

Telegrams: Pacera Slough

Obtainable from all leading Machine Tool Merchants, or write to us for details of your nearest stockist.

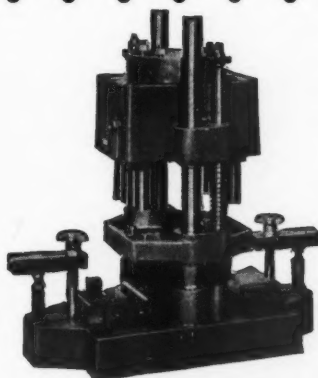
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## LET'S PUT OUR HEADS TOGETHER ON YOUR DRILLING PROBLEM

We supply precision built multi-spindle drilling and tapping Heads to suit your machine — for light, medium or heavy work and with spindles up to No. 5 M.T. Geared, gearless and adjustable types are available to meet your requirements. Additionally, we can supply complete tooling, fixtures, bushplates etc. for your particular application. We design and build special-purpose machines incorporating multi-spindle Heads to meet your own specific needs.



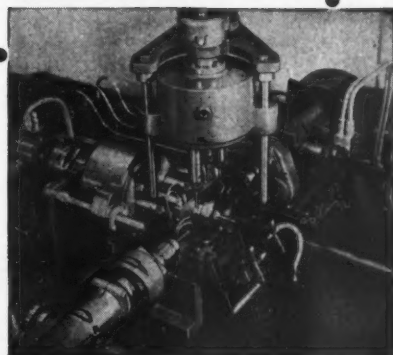
**MEDDINGS**

Write for full particulars to:—

**W.J. MEDDINGS LIMITED**

IPSWICH ROAD • TRADING ESTATE • SLOUGH • BUCKS

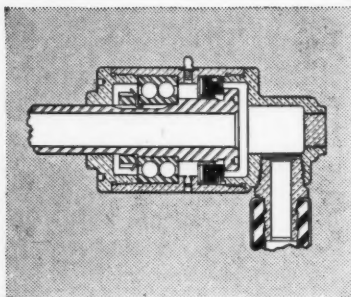
Phone: Slough 26761 (5 lines)



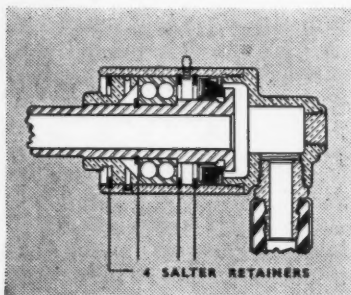
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## How costs are cut with **SALTER** RETAINERS

**Salter retainers simplify design of  
air, water, steam union, with great savings**



**THE OLD WAY** Air, water, steam union involved drilling, threading and milling operations. Maintenance was difficult.



**THE SALTER WAY** Salter retainers permit rapid, simple assembly and maintenance with a reduction in manufacturing costs.

### MATERIALS SAVED

decreased wall thickness of housing	2/9½
eliminated bearing lock nut and washer	7½ *

### MACHINE

#### OPERATIONS ELIMINATED

bore, undercut, and tap cap end of housing	1/4½
locate cap on arbor and chase threads	1/-
drill spanner wrench holes	4½
cut thread on rotor for lock nut	3½
mill slot in thread for tang on lock washer	7½
drill spanner wrench holes in rotor	4½

### ASSEMBLY

#### OPERATIONS ELIMINATED

install lock washer, tighten lock nut, bend lug	8½
assemble cap into housing	4

### TOTAL SAVING WITH SALTER RETAINERS

8/6½

**4 SALTER  
RETAINERS  
simplify  
design,  
assembly  
and  
maintenance  
with a  
saving of  
8/6½ per unit**

NEATER - MORE POSITIVE - PERMANENT RETAINING

# SALTER

TRUARC  
A J. I. TRUAX COMPANY



Circlips



Fasteners



Retainers



Fixes

Geo. Salter & Co. Ltd., West Bromwich. Spring Specialists since 1760

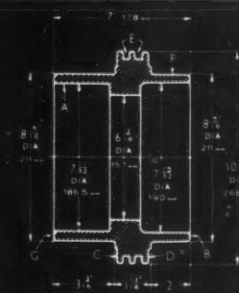
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## SPECIAL

## TOOLING LAYOUT No. 17

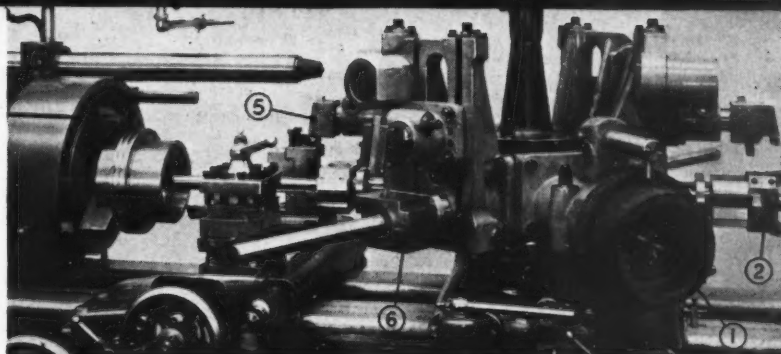


## PISTON

**Machined all over.**

**PERMALITE  
MALLEABLE  
IRON CASTING**

### Tungsten Carbide Cutting Tools.

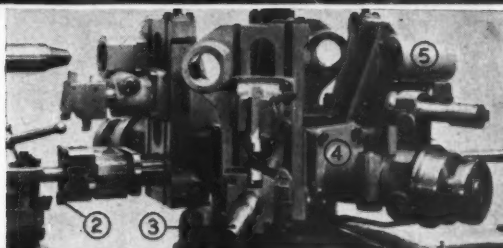


## No. 8 TURRET LATHE

**Code Word : Cevhylet**

Equipped with 15" — 3-Jaw Tudor Chuck.

**Total Floor to Floor Time : 22 mins.**



DESCRIPTION OF OPERATION	Tool Position		Spindle Speed R.P.M.	Max. Cutting Speed		Feed	
	Hex. Turret	Cross- slide		Feet per min.	Metres per min.	Cuts per inch	m/m. per rev.
1st Process							
1. Grip internally in "A" (using loading attachment) - - -	1	—	—	—	—	—	—
2. Rough face "B" - - - - -	—	S.T.1	102	229	69.7	98	-259
3. Rough knee turn $10\frac{1}{2}^\circ$ & $8\frac{1}{2}^\circ$ dia. and rough bore $7\frac{1}{2}^\circ$ & $6\frac{1}{2}^\circ$ dia. - - - - -	—	—	84	238	72.5	136	-187
Face "D" - - - - -	—	S.T.2	84	238	72.5	270	-094
4. Form grooves "E" - - - - -	—	Rear	102	282	89	270	-094
5. Finish knee turn $10\frac{1}{2}^\circ$ & $8\frac{1}{2}^\circ$ dia. and finish bore $7\frac{1}{2}^\circ$ & $6\frac{1}{2}^\circ$ dia. - - - - -	—	—	132	365	110.2	136	-187
6. Finish face "B" - - - - -	3	S.T.2	172	375	114	136	-187
7. Remove component (using attachment) - - - - -	4	—	—	—	—	—	—
2nd Process							
1. Chuck on "F" (using attachment) - - - - -	4	—	—	—	—	—	—
2. Rough face "G" - - - - -	—	S.T.1	102	229	69.7	98	-259
3. Rough knee turn $8\frac{1}{2}^\circ$ dia. and rough bore $7\frac{1}{2}^\circ$ dia. - - - - -	—	—	102	229	69.7	136	-187
Face "C" - - - - -	—	S.T.2	102	282	89	270	-094
4. Finish knee turn $8\frac{1}{2}^\circ$ dia. and finish bore $7\frac{1}{2}^\circ$ dia. - - - - -	—	—	172	375	114	136	-187
Finish face "G" - - - - -	—	S.T.2	172	375	114	136	-187
5. Remove component (using attachment) - - - - -	4	—	—	—	—	—	—

**'PRELECTOR'**  
Combination Turret  
Lathes  
with Preselective  
speed-changing.

**TURRET LATHES**  
with capacities up  
to 35 in. swing over bed

1½ in. to 2½ in. 'D-S'  
**'DOUBLE-SLIDE'**  
Capstan Lathes  
for heavier  
accurate work.

**Stock Tools,  
Toolholders, Chucks  
and Accessories  
for Capstan and  
Turret Lathes.**

**H. W. WARD**  
**& CO LTD**

SELY OAK, BIRMINGHAM 29

Phone: Selby Oak 1131





**For the Modern Machine Shop**

## Multi-spindle Drilling Machines with adjustable spindle centres

A range of these machines is available and all models have infinitely variable hydraulic feed and automatic cycle of rapid advance, feed, rapid return and stop. Any number of spindles, with either fixed or adjustable centres, can be provided within the machine capacity. A brief specification of each machine is set out below, and we shall be pleased to supply full particulars upon request.

### RANGE OF MACHINES

#### No 0

Fixed head, moving table  
Drive motor 5 or 7½ h.p.  
Drilling area 10in. diameter,  
10in. square or  
13½in. x 8½in.

#### No. 1

Moving head, fixed table  
Drive motor 10 h.p.  
Drilling area 12in. diameter,  
12in. square or  
16in. x 10in.

#### No. 2

Moving head, fixed table  
Drive motor 15 h.p.  
Drilling area 18in. diameter,  
18in. square or  
24in. x 15in.

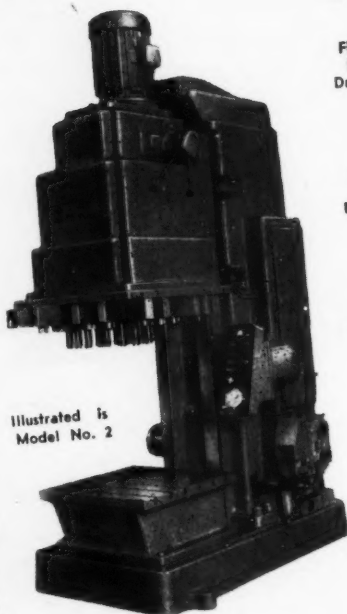
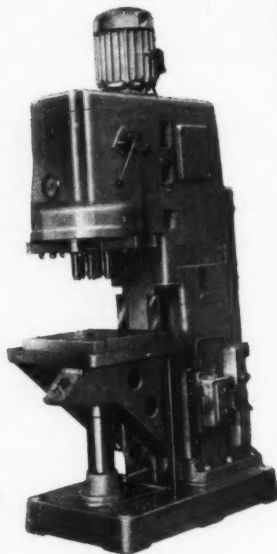
#### No. 3

Moving head, fixed table  
Drive motor 20 h.p.  
Drilling area 24in. diameter,  
24in. square or  
30in. x 18in.

#### No. 4

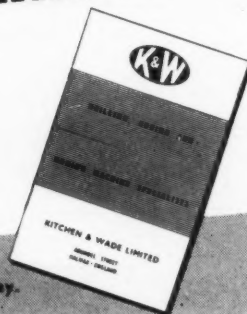
Moving head, fixed table  
Drive motor 25 to 30 h.p.  
Drilling area 30 in. diameter,  
30in. square or  
36in. x 24in.

The illustration  
below shows  
Model No. 0



Illustrated is  
Model No. 2

This 60 page catalogue illustrates and describes the range of K. & W. machines for the modern machine shop.



Write for this catalogue today.

# KITCHEN & WADE LTD.

Member of the Asquith Machine Tool Corporation

ARUNDEL STREET, HALIFAX, ENGLAND Telegrams: 'KAW, Halifax'. Telephone: Halifax 67744 (3 lines)

When answering advertisements kindly mention **MACHINERY**.

KW465



## Drilling Machines

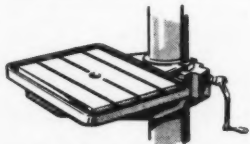
Don't just 'buy a drill'—invest in long life 'Elliott-Progress', the world's most popular drilling machine.

Models 4E and 5E offer 3 rates of auto-feed, tap reverse with no-volt release, oil bath and case hardened, nickel chrome gears.

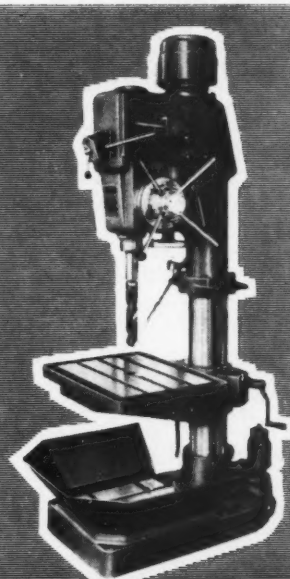
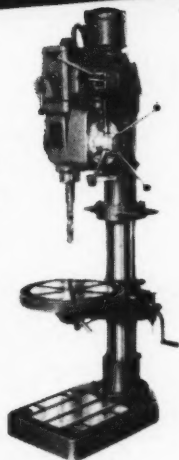


*more than a drill—  
an investment!*

**MODEL 4E**  
PILLAR DRILLING  
MACHINE  $1\frac{1}{4}$ " capacity  
9 spindle speeds, 73 to 1,065 r.p.m.  
Taper in spindle No. 3 M.T.  
Distance between spindle and  
column  $12\frac{1}{2}$ "

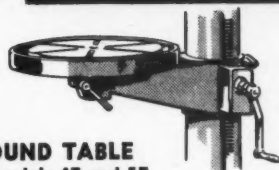


**RECTANGULAR TABLE**  
For models 4E and 5E

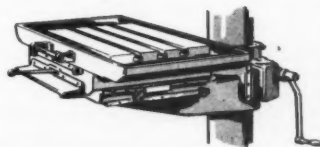


**MODEL 5E**  
PILLAR DRILLING  
MACHINE 2" capacity

9 spindle speeds, 58 to 839 r.p.m.  
3 rates of auto-feed.  
Tapping reverse, with  
incorporated no volt release.



**ROUND TABLE**  
For models 4E and 5E



**COMPOUND TABLE**  
Fully Universal Model  
For model 5E

**B. ELLIOTT**  
(MACHINERY) LTD

(MEMBER of the B. ELLIOTT GROUP)  
VICTORIA WORKS • WILLESDEN • LONDON • N.W.10  
Tel: ELGAR 4050 (14 lines) Grams: Elliottana, Harles, London  
Overseas Subsidiaries CANADA • U.S.A. • AUSTRALIA • S. AFRICA



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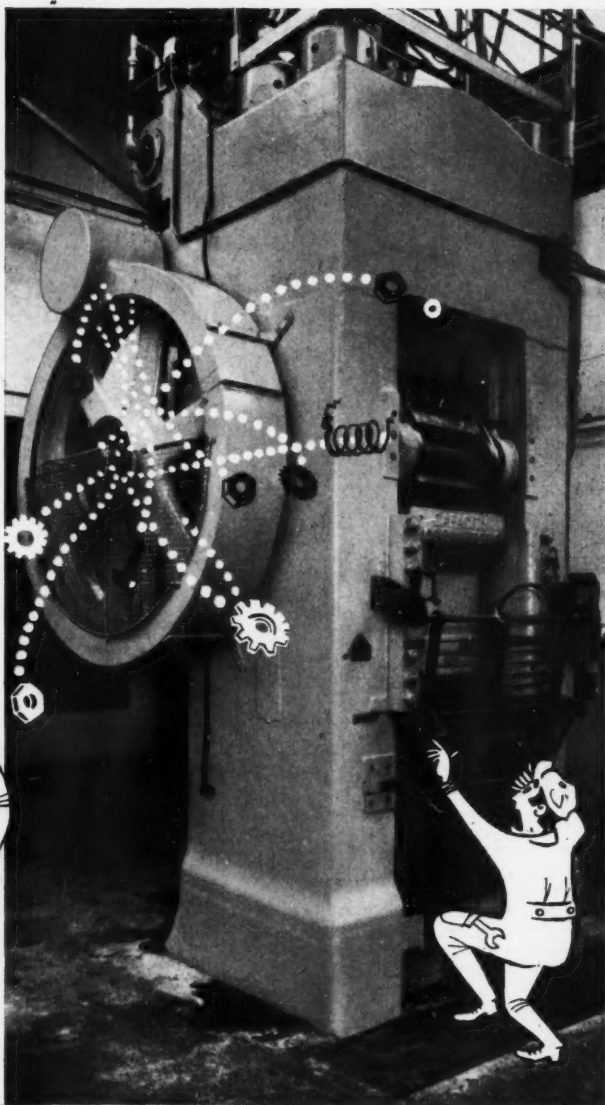
Joe's the boy for daydreams  
but when it comes to keeping  
up strict lubrication  
schedules he's likely to smash  
every dream of non-stop,  
top-capacity production!  
Happily nothing tempts  
Tecalemit Mechanical  
Lubrication Systems away  
from duty. Minute by minute  
metered shots of lubricant are fed  
to each and every bearing.  
Machines run more smoothly,  
have longer working life, give  
more reliable service. There  
are systems in the Tecalemit  
range to fit all machines  
and plant—new or existing  
—and to handle all lubricants  
—oil or grease. Get them  
to work for you and let Joe  
dream on, or, even better, find  
him a more productive job!



## TECALEMIT

*the Authority on Lubrication*

TECALEMIT (ENGINEERING) LIMITED (SALES M)  
PLYMOUTH · DEVON



To Tecalemit (Engineering) Limited (Sales M) · Plymouth · Devon

Please send me full information on:

SINGLE-LINE Grease Injection System—feeds each bearing through an independently regulated injector. ☐ RADIAL Grease Pump System—uses 19 miniature pumps to serve individual bearings. ☐ BRENTFORD Automatic Multiline Oiling System—has one to twenty-four lines, each with an independently regulated pump. ☐ BLUR Single-Line Oiling System—one central pump serves up to 100 points, each with a pre-regulated metering valve. ☐

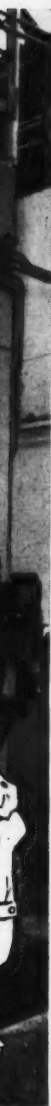
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COMPANY \_\_\_\_\_

ADDRESS \_\_\_\_\_

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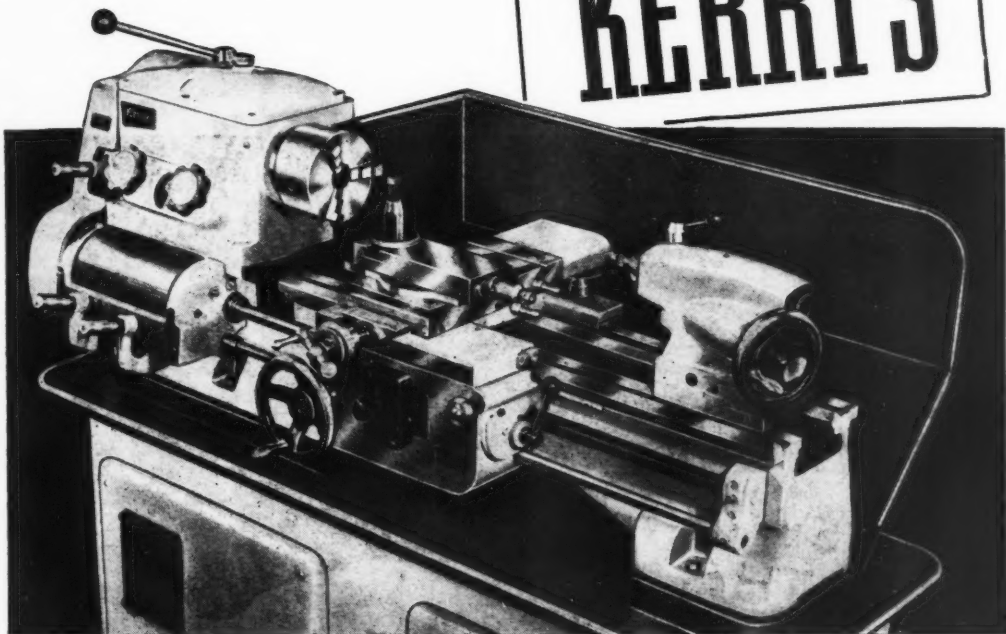
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**MORE AND MORE  
ARE TURNING TO**

**KERRY'S**



## **11" SWING LATHES**

*THOUSANDS in use in Great Britain  
and throughout the World!*

- ★ SLIDING, SURFACING AND SCREWCUTTING LATHE
- ★ ALL GEARED HEADSTOCK GIVING 9 SPEEDS RANGING FROM 39-1500 r.p.m.
- ★ TYPE LOO PRECISION TAPERED SPINDLE NOSE
- ★ FEED BOX GIVES 62 PITCHES AND 7 FEEDS FROM .0004 in.-.024 in.
- ★ CAMLOCK TAILSTOCK
- ★ BEDWAYS AND SLIDES PRECISION GROUND
- ★ HARDENED BEDWAYS OPTIONAL EXTRA

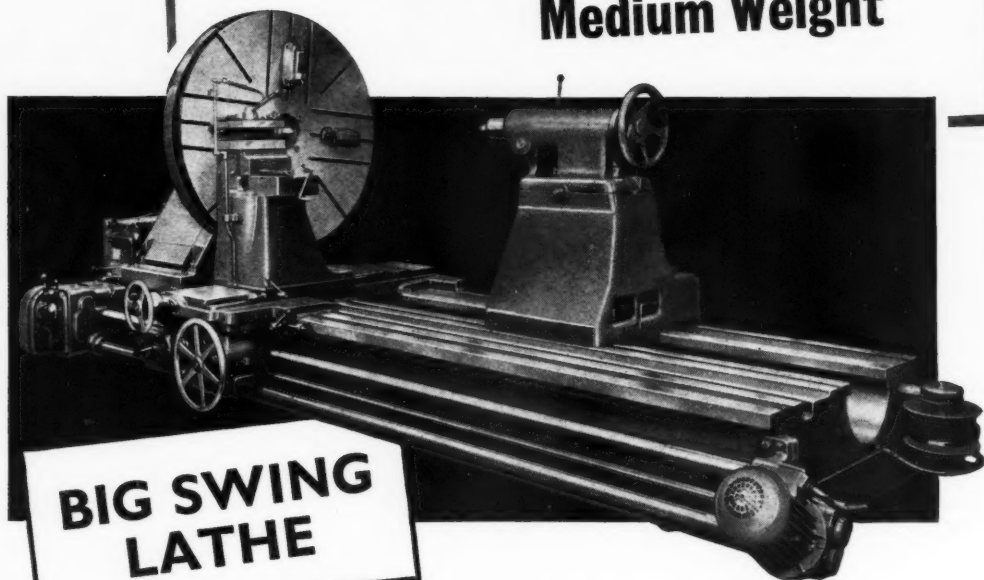
**KERRY'S**

manufactured within the KERRY GROUP by  
**KERRY'S (Engineering) CO. LTD**  
GRANGE ROAD, LEYTON, LONDON, E.10

A Kerry COMPANY

Sales Office: WARTON ROAD, STRATFORD, LONDON, E.15. Telephone: MARYland 6611

## For Turning **LARGE** Diameter Drums and Rollers of Medium Weight



### BIG SWING LATHE

The O & S Range also includes:

SS & SC lathes from 10½ in. to 24 in. capacity; surfacing and boring lathes up to 96 in. swing; break lathes; railway carriage and wagon wheel lathes; axle journal turning and burnishing lathes; straightening presses.

This lathe will swing up to 6 ft. over the saddle and is specially designed for Turning Drums, Rollers, etc. It is easy to handle, economical in operation and competitively priced. The Big Swing also makes this an ideal machine for general maintenance work.

**The O & S Big Swing Lathe incorporates all these features:**

- Up to 6 ft. swing over saddle
- Up to 25 ft. between centres
- 12 spindle speeds
- Large hollow spindle
- Spindle bearings PB or Taper Roller
- 32 enclosed change feed and screw-cutting box
- Long lead cutting gear
- Quick power motion to saddle
- Power feed to compound top slide if required
- Power feed to loose head-stock if required
- 30 or 35 H.P. motor drive



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BOOTH TOWN, HALIFAX, YORKSHIRE

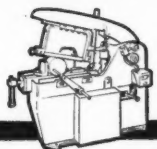
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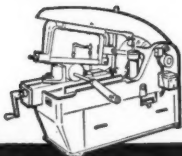




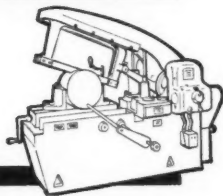
8 INCH



10 INCH



12 INCH



Full details from  
your machine tool  
merchant or  
our Sales Office

*The Famous* **Q&S**

## SAWMASTERS

**are the finest  
HEAVY DUTY HACKSAWS  
in the world**

Modern in design, robust and precise in construction, these unrivalled machine saws cut accurately and rapidly, and offer maximum production efficiency. Refinements include totally enclosed drive, hydraulic relief on the return stroke and automatic lifting of the bowslide to loading position on completion of cut.

Instant lever selection of correct cutting speed is a feature of all but the smallest model.

—and the famous *SAWMASTER Autocut Power Bandsaw*.



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## HEAVY DUTY Vertical BORING & TURNING MILLS

**with 5, 6, 8 or 10 ft diameter work tables**

These incomparable machines are massively constructed for years of hard service. Accuracy and dependability are of the high order that industry has learned to expect of Broadbent Machine Tools. Notable features of these Boring and Turning Mills include twelve changes of speed and six changes of feed, controllable from either side of the machine; spiral bevel and spur reduction gears driving the work table; pendant control of rams and cross slides; and rapid power traverse with independent control of the two heads.

*Please write for fully illustrated brochure.*



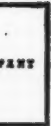
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**Sales Office: WARTON ROAD, STRATFORD, LONDON, E.15. Telephone: MARYland 6611**

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**DE LAVAL**

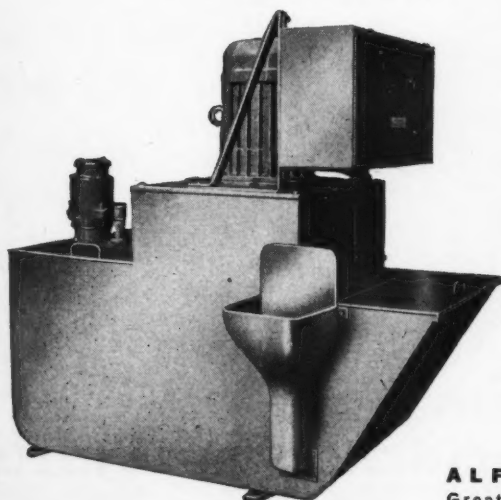
## **CENTRIFUGAL COOLANT CLARIFIERS**

**ensure  
HIGH-CONSTANT  
Clarifying  
Efficiency**

**unattainable by  
any other method**

- \* Closer grinding limits and better surface finish.
- \* Prolongs tool and wheel life—less dressing required.
- \* Extends coolant life and maintains maximum hygiene for operator.
- \* Reduces labour and material costs.

For full particulars please consult our technical engineers . . . contact our **FACTORY EQUIPMENT DIVISION.**

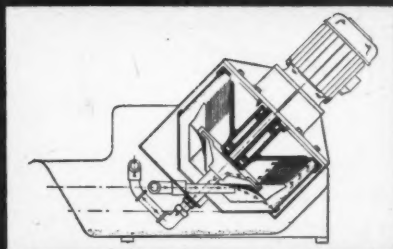


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**TURBO MATIC  
CENTRIFUGE**

Type BX 215-34S

Rated capacity 3480 g.p.h.  
(depending on application)



**DE LAVAL**

**TURBO MATIC MINOR  
CENTRIFUGE**

Type WX 209-34

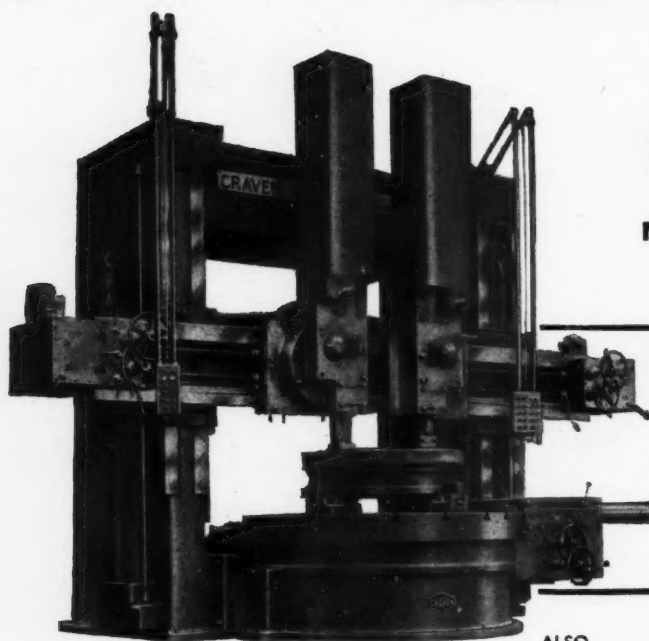
Rated capacity 750 g.p.h. (depending on application).  
Fully automatic in operation including  
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without interrupting flow of coolant.

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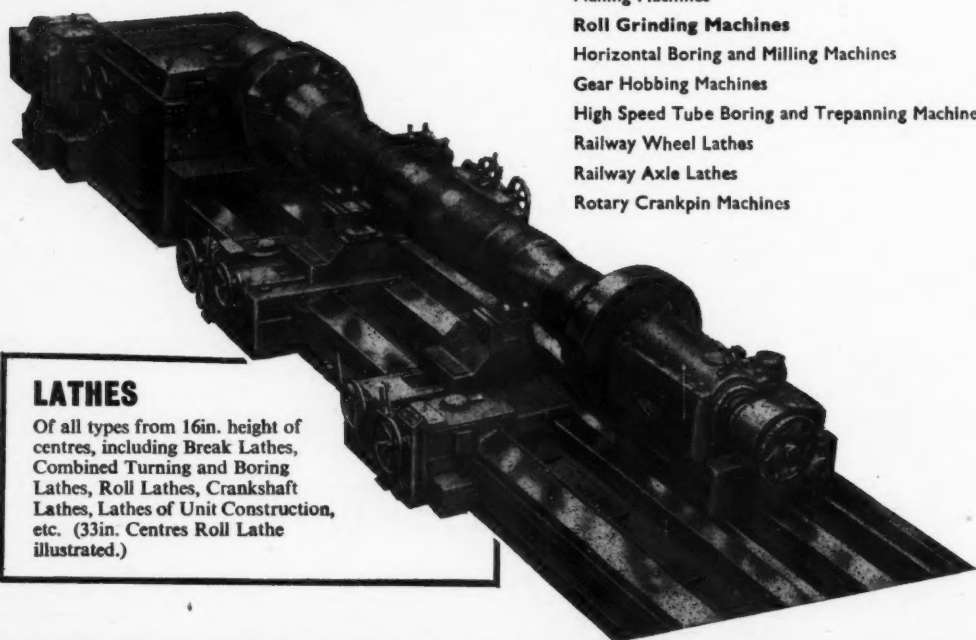
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### **VERTICAL BORING & TURNING MILLS**

From 8ft. 0in. diameter capacity.  
Side Head, Profile Copying, Pre-  
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Constant Cutting Speed Control, etc.  
(10ft. 0in. Mill illustrated).

#### **ALSO**

Planing Machines  
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High Speed Tube Boring and Trepanning Machines  
Railway Wheel Lathes  
Railway Axle Lathes  
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### **LATHES**

Of all types from 16in. height of  
centres, including Break Lathes,  
Combined Turning and Boring  
Lathes, Roll Lathes, Crankshaft  
Lathes, Lathes of Unit Construction,  
etc. (33in. Centres Roll Lathe  
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VAUXHALL WORKS · REDDISH · STOCKPORT · ENGLAND

CMT.31

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**NEW****SICMATIC**

## Automatic and Semi-Automatic Hydraulic Profiling Lathes

### Specification

Bore of spindle	..	2½ in.
Spindle nose	..	5 in. A.S.A.
Max. swing over bed	..	15½ in.
Max. swing over saddle	..	9½ in.
Max. length turned	..	27½ in.
Hydraulic traverse of copying slide	..	4 in.
Hydraulic feed of tailstock spindle	..	4½ in.
Number of feed rates to copying slide	..	48
Max. tool pressure	..	1,300 lbs.
Approx. net weight	..	5,000 lbs.

**7**

### POINT FEATURES INCLUDE

- 1 Capacity.
- 2 Diplomatic Hydraulic Systems.
- 3 Hardened Bed Slideways.
- 4 Auto cycling up to six depths of cut.
- 5 Hydraulic tailstock for drilling and boring.
- 6 Uses template or existing component.
- 7 Eight models to choose from.

**Basic price under £2,500.**

### QUICK DELIVERY

Daily demonstrations at our works



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# OIL FOR BUSY BEARINGS

Correct bearing lubrication is the first essential of efficient machine tool operation.

Aiding you in this important phase of machine tool lubrication are the GENA range of lubricants. They comprise oils of specially graded viscosity ratings to lubricate all types of spindles, plain bearings and gear boxes.

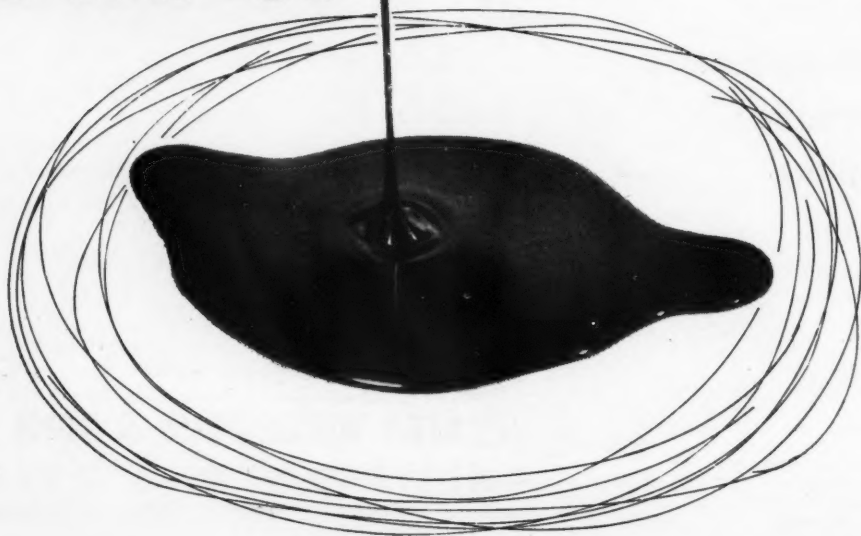
To select the proper grade for your usage, write for Publication SP.178 "Machine Tool Lubrication", or ask our Technical Representative to call.

## **FLETCHER MILLER**

### *Machine Tool Lubricants*

**GENA** THE MACHINE TOOL LUBRICANT  
**ALMARINE** FOR ALL GREASE POINTS  
**VETA** FOR HYDRAULIC SYSTEMS GENERALLY

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# DIE MATIC

**AUTOMATIC HYDRAULIC  
DUPLICATING  
DIE-MILLER combined  
with a  
TOOL-ROOM  
MILLING  
MACHINE**

## SPECIFICATION

Working surface	43in. x 10in.
Max. dist. spindle to table	14½in.
Longitudinal table trav.	
(hydr. + manual)	14in. + 14in.
Vertical (knee)	
hydr. + manual	4in. + 13in.
Vertical (quill)	
(mechanical)	5in.
Cross (saddle)	
(hydr. + manual)	10in. + 10in.
Spindle speeds range r.p.m.	80 to 2715

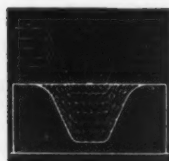
**PRICE £2,125 - 0 - 0 ★**

### 3 Hydra-Way Duplicating (Finishing)

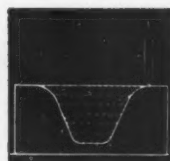
★ Special terms for members of B.A.M.T.M.



1 Automatic Horizontal Scanning of the Model "by Lines"



2 Vertical Depth Duplicating Multicuts by Parallel Layers



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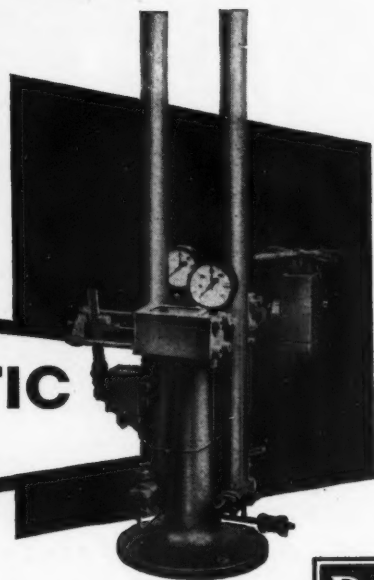
# MODERN HYDRAULIC ACCUMULATORS-

BY WERNER AND PFLEIDERER

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- ★ No electrical controls
- ★ Extremely smooth operation
- ★ Maximum efficiency
- ★ Low cost of installation
- ★ Extreme economy of floor space
- ★ Easily adjusted working pressure
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—equipped with the unique

## HYDRO-PNEUMATIC AUTO-CONTROL



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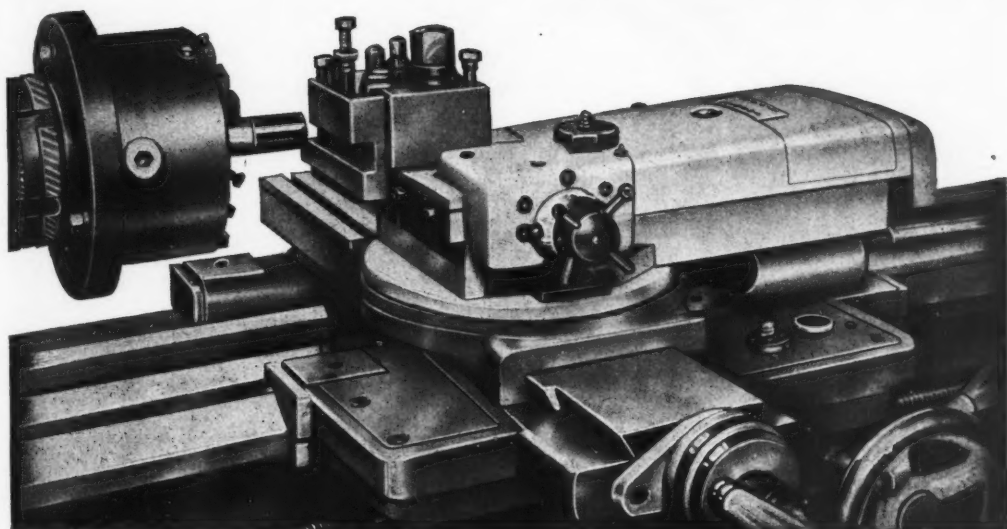


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# FILEMATIC

## high speed THREAD CUTTING ATTACHMENT



**Write today  
for complete  
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- ▶ FITS ANY CENTRE LATHE
- ▶ CUTS ANY THREAD...  
INTERNAL OR EXTERNAL  
CYLINDRICAL OR TAPER
- ▶ MAXIMUM LENGTH 1½ in.  
MAXIMUM PITCH 5. T.P.I.
- ▶ THREAD RIGHT UP  
TO A SHOULDER...  
INSTANT WITHDRAWAL
- ▶ EQUALLY SUITABLE FOR  
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LARGE SCALE PRODUCTION

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CANAL STREET WORKS · NOTTINGHAM · ENGLAND

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**with SEEGER CIRCLIPS**



**Automotive Engineering Limited**

The Green, Twickenham, Middlesex

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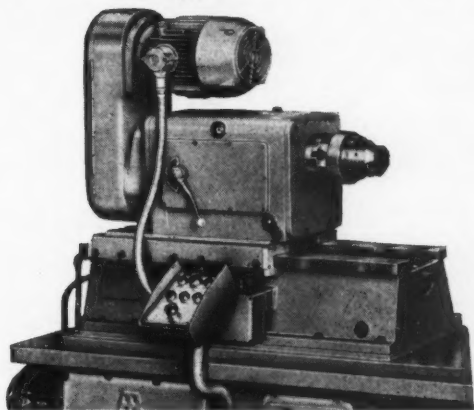


# BERARDI

*A name in Europe synonymous with*

# AUTOMATION

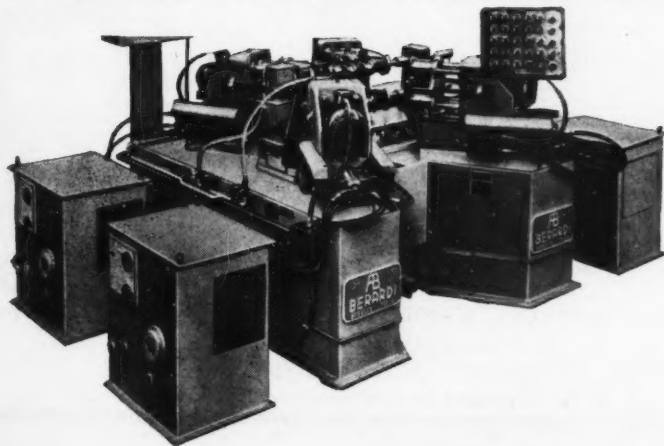
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In Association with the Houghton group of companies all over the world



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**HOT AND COLD COMPRESSION  
MOULDS**

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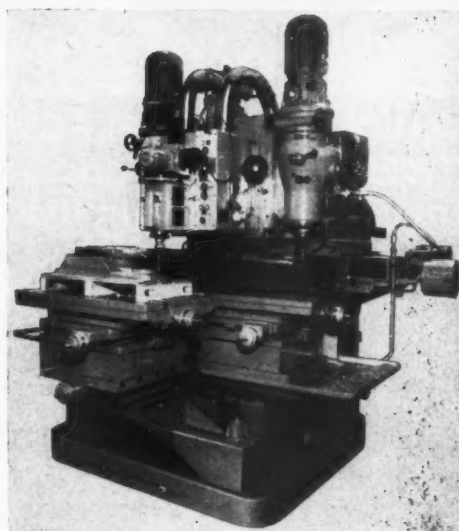
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**INJECTION MOULDS FOR PLASTICS**

The machine illustrated is a fully automatic type equipped with 2 milling heads for the simultaneous production of two components. The copying range is  $31\frac{1}{2}$  in. x  $15\frac{3}{4}$  in. x  $4\frac{1}{2}$  in. deep.

Other die sinking machines in the Nassovia range are available with one milling spindle for automatic operation and for hand operation.



*Sales and Service for the British Isles*

**DRUMMOND-ASQUITH LIMITED**

*Member of the Asquith Machine Tool Corporation*

KING EDWARD HOUSE, NEW ST., BIRMINGHAM Phone: Midland 3431. Also at LONDON Phone: Trafalgar 7224 & GLASGOW Phone: Central 0922

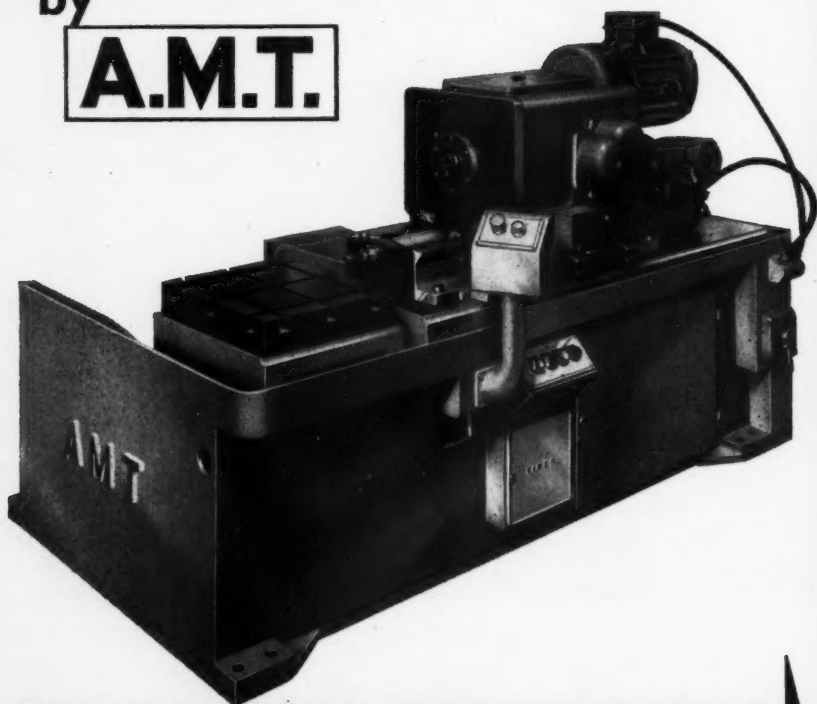
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by

**A.M.T.**



with **BUILT-IN SELECTION FOR ALL THESE CYCLES** brings **AUTOMATION** for small or quantity production at unusually low cost

Here is a "multi-cycle" machine within the price range of a single-operation production machine which has been developed especially for batch or quantity production. It is available in three sizes—2 h.p., 5 h.p. and 10 h.p. for horizontal or vertical application.

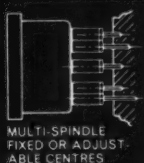
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REGISTERED TRADE-MARK

## IMPROVED METHODS OF INDUCTION HEATING

Many high production processes are best carried out by radio frequency heating . . . best because of its inherent controllability; best for blunt indisputable facts of economics.

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Radyne Ltd are leaders not only in the theory of induction heating but also in the best ways of using it in practical, down-to-earth industrial problems. We will be happy to discuss your problems without obligation.

**Please use the coupon below.**

*A line of R.F. induction heaters in service with the Ford Motor Company, Basildon, Essex.*



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R.F. heating will harden components locally with the greatest precision, and is far quicker and cheaper than conventional methods of surface hardening, localised through hardening, and tempering.

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Soldering and brazing by induction are quicker and cleaner than by conventional methods. Localised heating restricts the flow of solder to the joint area. Both parts to be joined are raised to working temperature together. Scale and discoloration are reduced to a minimum.

### THROUGH HEATING

In forging, stamping, and other processes, rapid through heating to forging temperature saves time and space, reduces scaling and in consequence wear and tear on dies, improves dimensional accuracy, and gives better working conditions.

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Localised annealing between processes can be carried out with greater speed and control by induction methods than by any other.



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new  
frontiers**

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Induction heating

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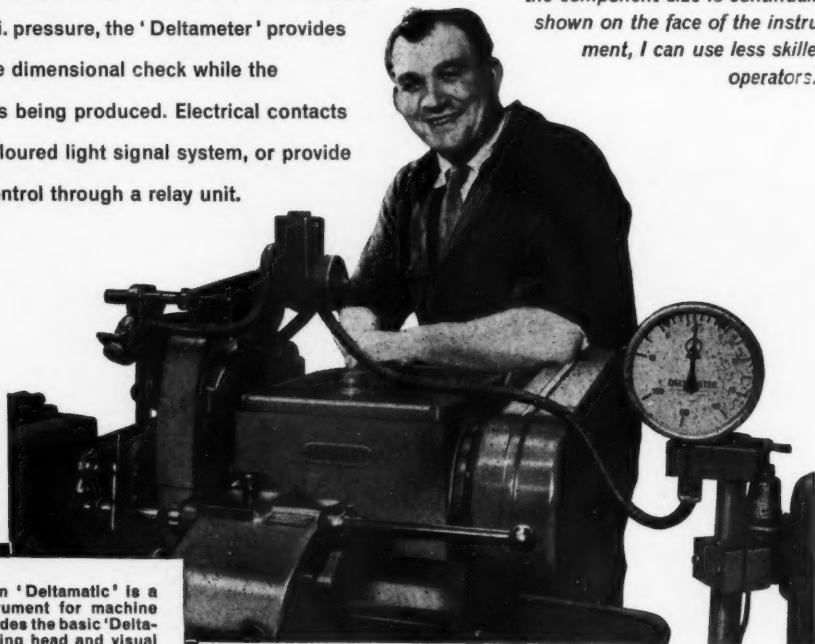
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**Your older machines can produce to .00005" tolerances with the continuous reading 'Deltameter'**

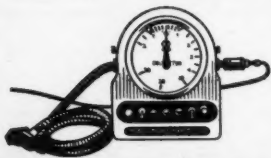
The Johansson 'Deltameter' provides a continuous dimensional check during manual or automatic grinding operations. Operating from any factory air supply above 25 p.s.i. pressure, the 'Deltameter' provides an immediate dimensional check while the component is being produced. Electrical contacts operate a coloured light signal system, or provide automatic control through a relay unit.

## MACHINE SHOP FOREMAN SAYS:

*" 'Deltameter' installations brought older machines into operation again, eliminated rejections, and saved hours of manual checking by conventional methods. What's more, as the component size is continually shown on the face of the instrument, I can use less skilled operators."*



The Johansson 'Deltamatic' is a universal instrument for machine control. It includes the basic 'Deltameter' measuring head and visual indicator, plus a built-in relay unit.



**CEJ JOHANSSON LTD.**

Write for information to:

Specialists in threading and precision measurement.

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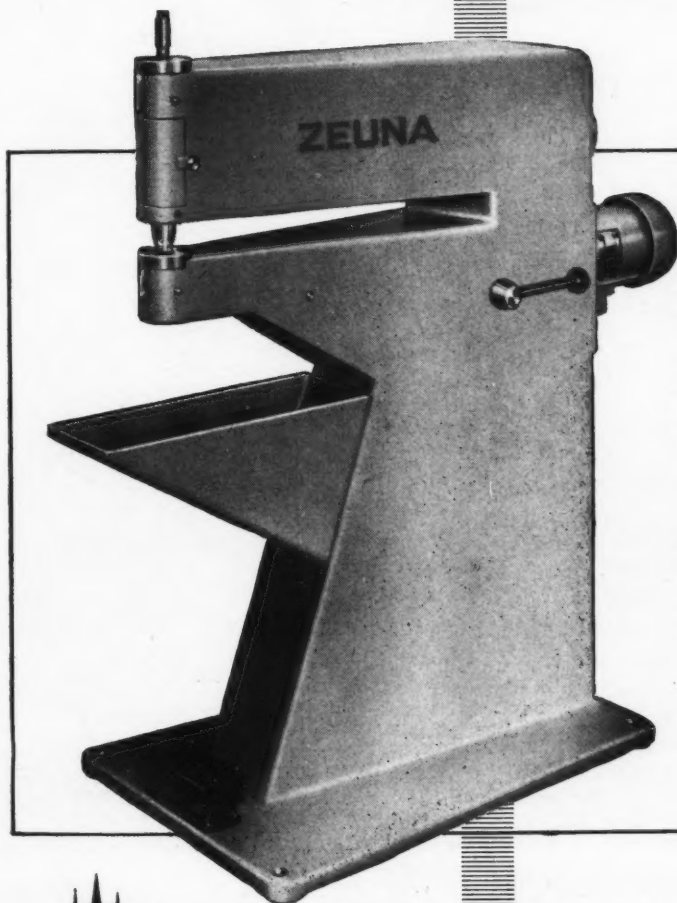
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## Combined

## NIBBLING MACHINE



- The combined machine consists of a cantilever upper nibbling arm and a lower counteracting arm, both having a common drive.

- Permits the machining of metal sheets and bands of any length and width.

- The novel mounting of the holding down device makes it possible to cut a minimum inside radius of 0.32in. as well as any outside radius or acute angle; it even enables swivelling on the spot.

- Will cut any shape out of the centre of a metal sheet.

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Cables: 'Modern' Coventry

SM/MMT 6321

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Waiting  
for...

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The result of over 30 years experience. Available with 4-speed Gearbox or Ward Leonard Drive. Laminated plastic on table guide-way improves running. Table drive through helical gears. Single and Double Column models. Grinding and Milling Heads can be fitted.

**for rapid  
metal removal**

**rugged-accurate**

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**EXCLUSIVE**

DISTRIBUTORS OF THE FINEST MACHINE TOOLS

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**Tapershank performance...  
Jobber's cost**



## ***Clarkson TaperFast System***

For you TaperFast means an immediate reduction in your drilling expenditure. For every size of Jobber Drill you use from  $\frac{1}{8}$  in. —  $\frac{1}{2}$  in., A—Z or 1—31, you can now use a Tapershank Drill, but it will cost you no more than you are now paying for your Jobbers. This means that you

can have Tapershank performance at Jobber's price.

If you want to know more about this new advance in drilling technique, all you have to do is to write or phone your nearest Clarkson Service Centre.

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## CHECK THESE FEATURES!



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**UNSURPASSED ACCURACY**—Famed Kodak Ektar® lenses guarantee reliable measurements with clear *accurate* images over entire screen.



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**ERECT—UNREVERSED IMAGE**—Correct, normal appearing images at all magnifications, eliminate confusion, simplify operation and save time.



**COATED LENSES AND MIRRORS**—Produce clear sharp images characteristic of Ex-Cell-O Contour Projectors. Have been standard on all models for many years.



**BRIGHT, GLARE-FREE SCREEN**—The "Fresnel" lens is exclusive with Ex-Cell-O, permits operator to see entire screen evenly illuminated from normal position. No "hot spots".



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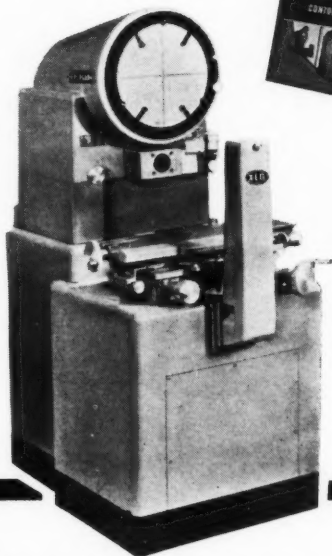


**RUGGED CONSTRUCTION**—The long established reputation of Ex-Cell-O for precision and quality assures years of trouble free operation.



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# Karl Hüller GmbH. Ludwigsburg

## Plano Milling Machines

with programme control

Power required per unit horse power 5-50-10-20-40

Table sizes - - 17½ in. by 51 in. 22 in. by 70¾ in.  
17½ in. by 70¾ in. 21 in. by 90½ in.

Horizontal or vertical design.

Simplex or Duplex machine.

Standard programme for longitudinal automatic control.

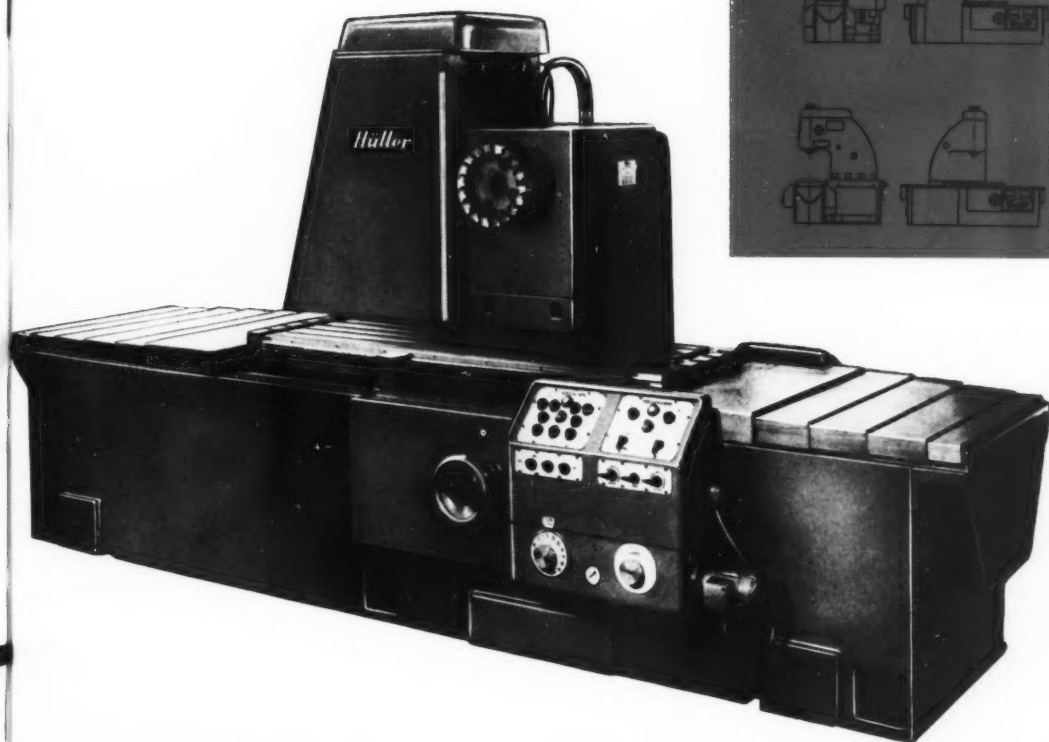
Special programme for longitudinal vertical automatic control.

Hydraulic clamping of unit and quill.

Hydraulic cutter lifting device.



# Hüller



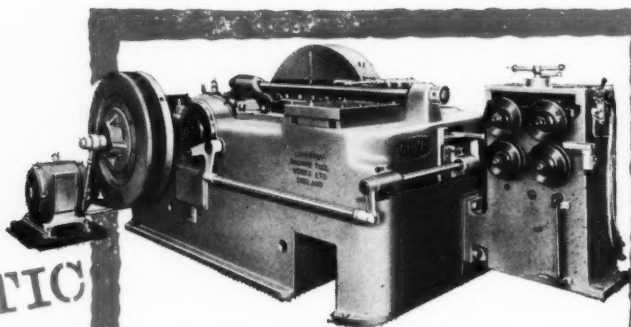
## Bishop, Eaves & Sons, Ltd.

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Telephone: East 4071



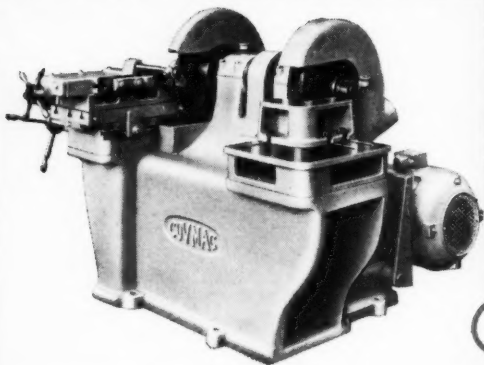
## AUTOMATIC FORGER



No. 2 machine with guards removed.

The stock is placed between the rolls and is then fed through the dies to the workstop. The die then closes, cutting off the stock to the required length, and delivers it to the heading position. The heading tool then completes the forging, which falls down the chute and is taken away by conveyor.

The Automatic Forger can be supplied in several sizes and for making balls of up to and including 4in. diameter.



No. 3 machine illustrated.

These machines are made in three sizes. The smallest handles bars up to 2in. diameter. The largest size, as illustrated, takes bars up to 4in. diameter. They are an invaluable asset to any forging or drop stamping plant. We also make nine sizes of Standard Upsetting Machines to take bars from 1/2in. to 6in. diameter.



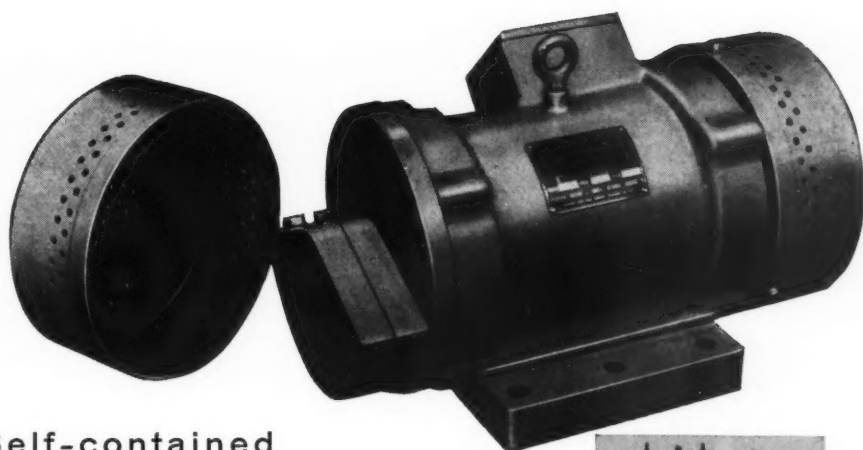
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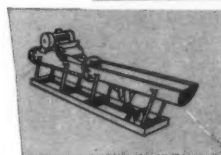
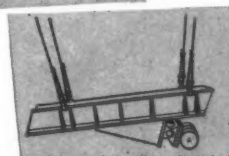
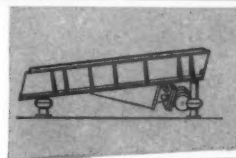
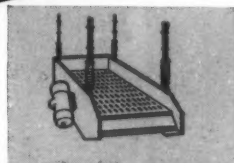
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for all  
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**Hoppers Foundry Shakeouts Screens**  
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**Confectionery Moulds Vibratory Massage Machines**

These motors eliminate all parts associated with eccentric shaft arrangements and can be used wherever a vibrating motion is required. Vibration is generated by out-of-balance weights at each end of the motor and single-bolt adjustment gives outputs up to 7,760 lb. centrifugal force at 1,500 r.p.m.

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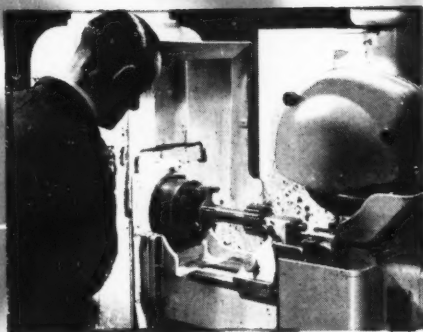


**GRINDING****HEAVY DUTY****GEARS FOR****SCAMMEL**

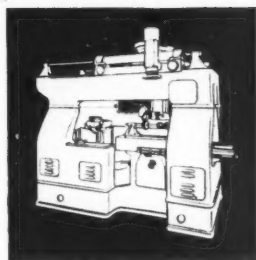
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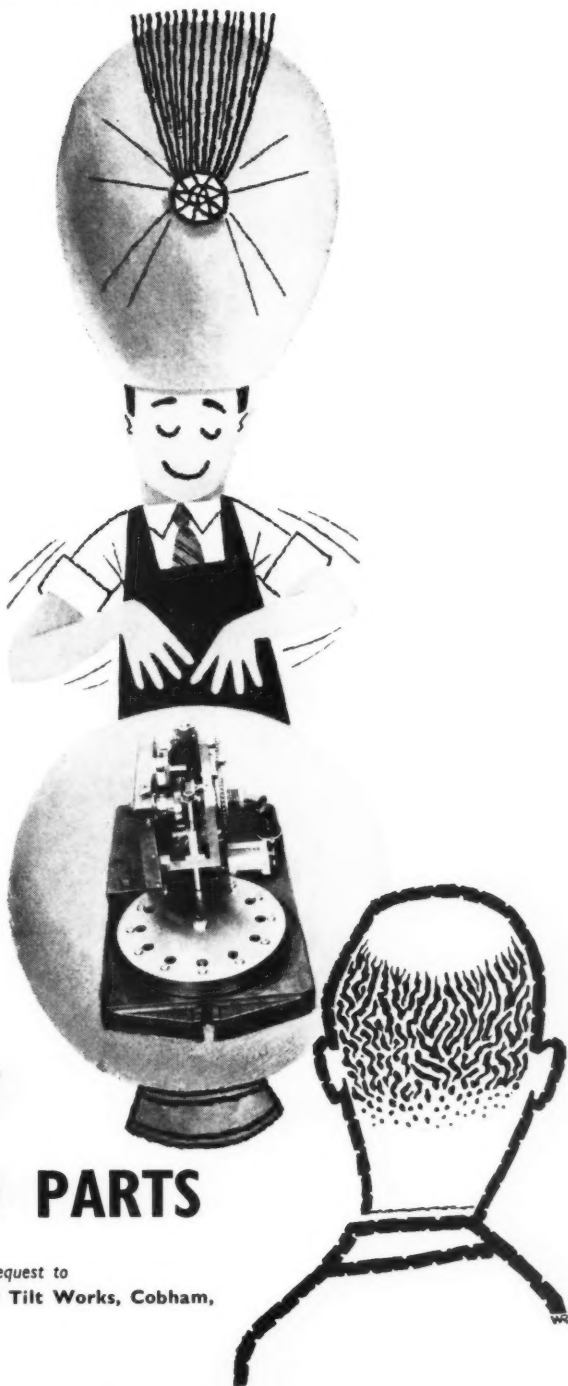
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 Thread Grinders, Jig Borers, Jig Grinders, Worm Grinders

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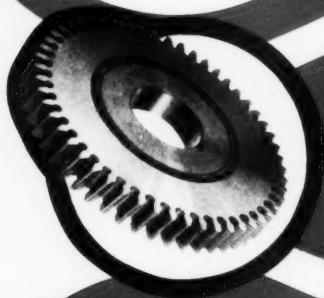
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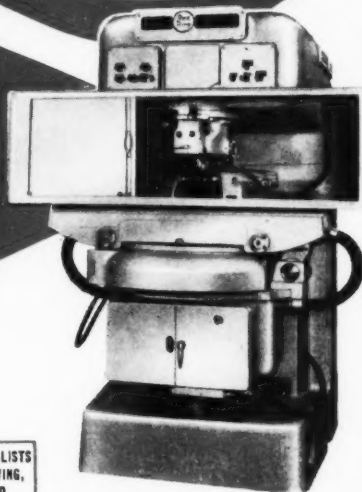
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pinion was shaved in  
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**OMT**

30 INCH  
ROTARY  
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WITH **EMI**  
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## PRECISION

Built for inspection or production functions, the table has a spacing accuracy within  $\pm 3$  secs. . . . . equal to that obtained with the most precise optical tables. The centre setting plug revolves to within 0.0001" of absolute concentricity—the platen rotates in one plane to within 0.0002".

For further details of this high precision, cost saving unit, apply to:-

## PRODUCTIVITY

As a guide to production economy accomplished with the table, the following statistics would relate to drilling 100 holes in a plate on a 24" pitch circle diameter, all within 0.0002" spacing accuracy and assuming a drilling time of 5 seconds per hole.

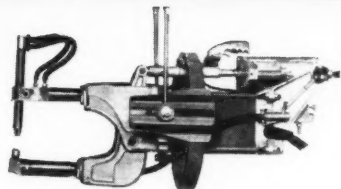
Time for complete revolution of platen . . . . 40 secs  
Time for positioning and clamping (5 secs x 100) 8 mins 20 secs  
Drilling time (5 secs x 100) . . . . . 8 mins 20 secs  
TOTAL PRODUCTION TIME . . . . . 17 mins 20 secs

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## from any angle

The ARO Spot Welding Gun gets *to* the work from any angle and it gets *on* with the work—quickly and reliably. ARO guns are versatile, readily installed and adaptable to design changes. Automatic, safe, and fast in use. Equally popular with management and with operators. The ARO range of welding guns gives you an unparalleled choice of hand-, air- and oil-operated guns, with exchangeable arms and tips, to suit all conditions and applications. Look at it from any angle, ARO Spot Welding Guns are spot-on for top speed, top quality, top profit. Get full details about ARO—on the spot.

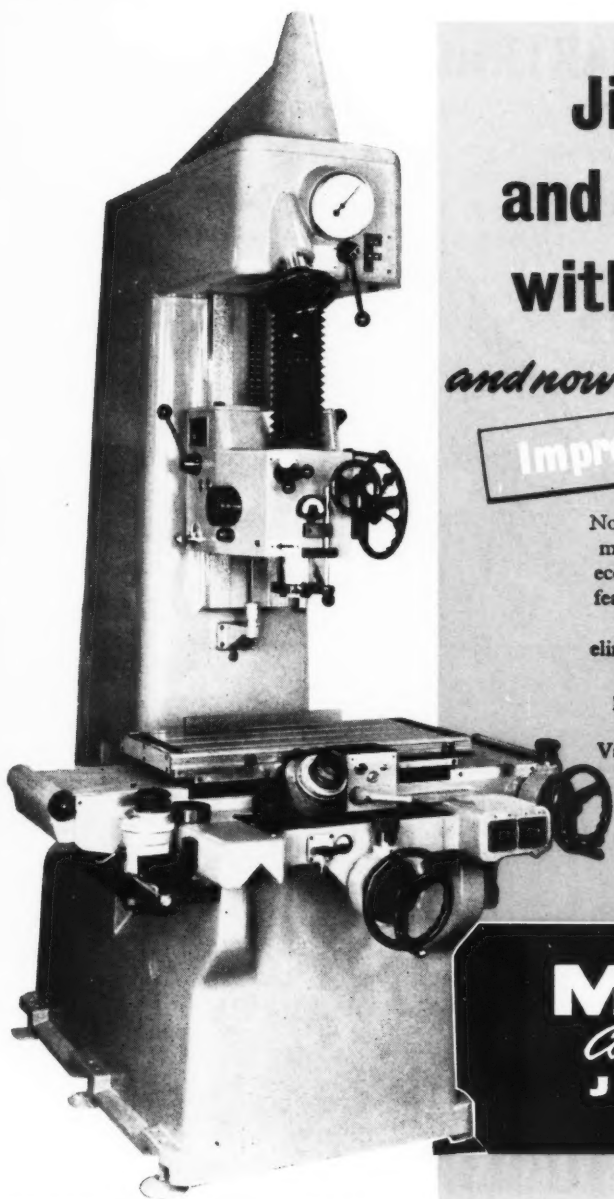


ARO 510 Air-operated; water-cooled; arm length up to 41" ; wide range of quick-change arms and electrodes; gyroscopic suspension, easily pedestal mounted; 1,350 lbs. electrode force; 12,000 Amps welding current;  
Welds up to  $\frac{3}{16}$ "  $\pm$   $\frac{3}{16}$ " ferrous metals  
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**Improved OPTICS**

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New direct optical positioning eliminating locating rods and blocks.

Instant location by fast traverse, precise spacing by direct reading, table 12in. by 24in.

Vari-speed drive, 70 to 2500 r.p.m.

**EARLY DELIVERY**

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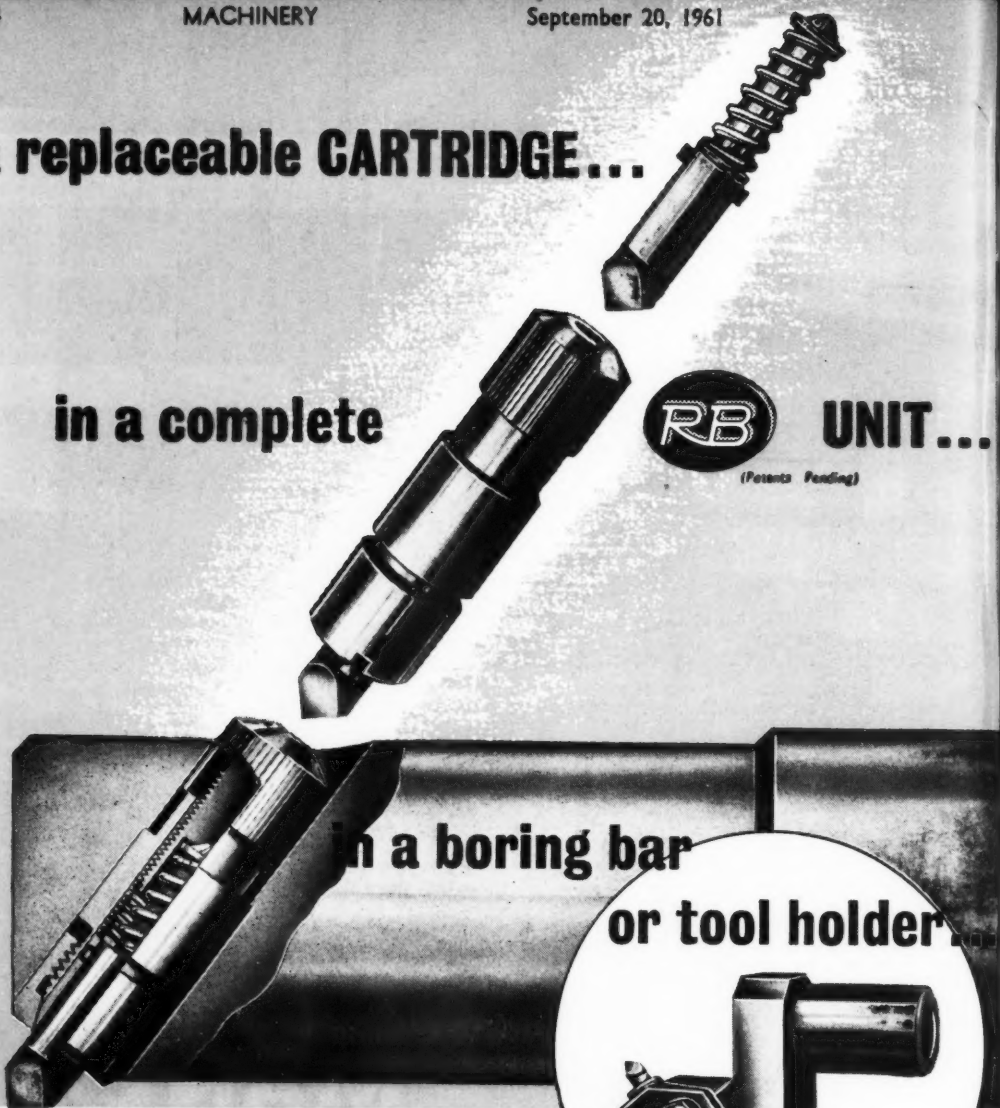
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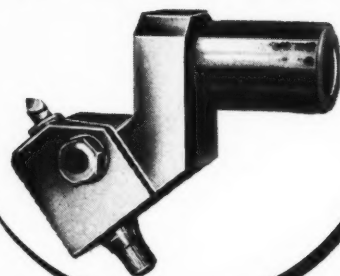
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(Patents Pending)



**in a boring bar**

**or tool holder...**



**..gives you the ultimate  
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FOR BORES FROM .590in. UPWARDS

*R.B. Cartridge Tooling gives  
positive final adjustment —  
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16" x 40" (60")  
HIGH SPEED PRECISION LATHE

**DEMONSTRATIONS DAILY  
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**ALL THESE FEATURES  
— AND MORE —  
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16 Spindle Speeds  
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Hardened  
and Ground  
Gears

10 h.p.  
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Nickel-Chrome Steel  
Spindle running in  
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Instant  
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Table Type  
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Distance between Centres	40" or 60"
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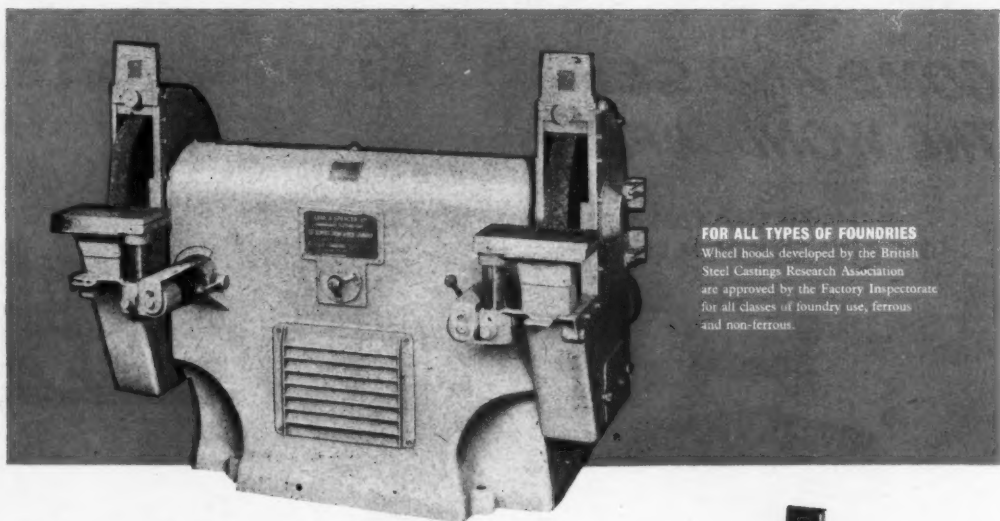
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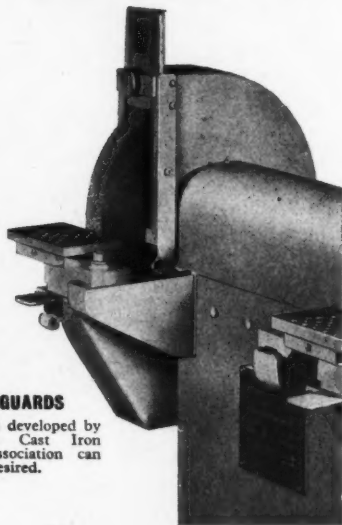
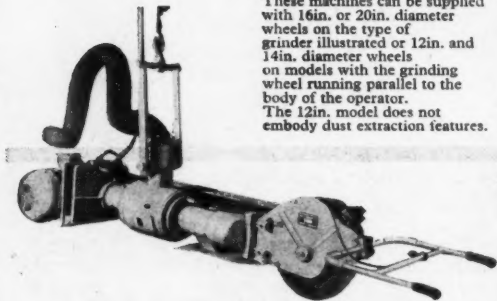
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These machines can be supplied with 16in. or 20in. diameter wheels on the type of grinder illustrated or 12in. and 14in. diameter wheels on models with the grinding wheel running parallel to the body of the operator.

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Wheel hoods developed by the British Cast Iron Research Association can be fitted if desired.

**ABRASIVE WHEELS**

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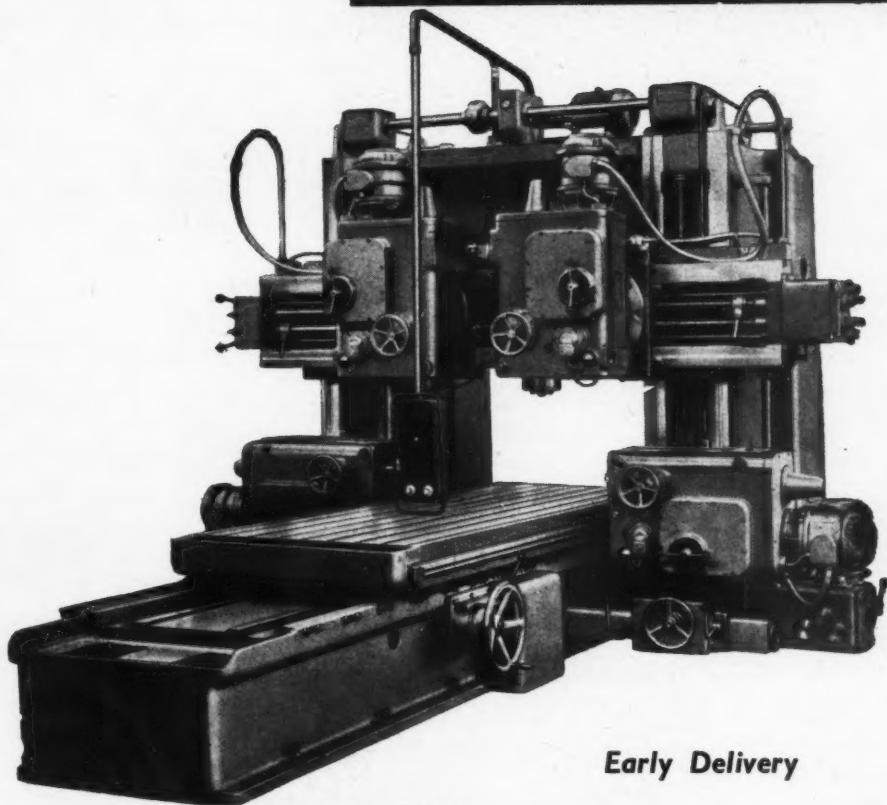
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- Independent drive to individual headstocks, individual drive to table and headstock feeds.
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*The  
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is  
Efficient  
But hardly a*



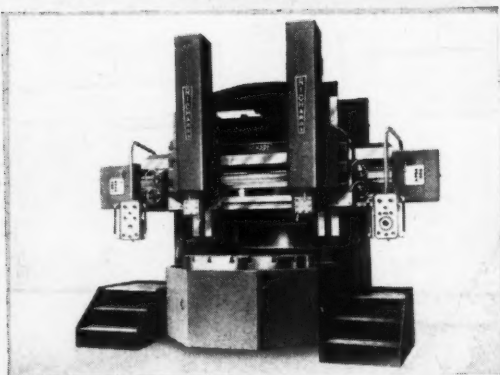
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HORIZONTAL and VERTICAL BORERS produced by GEORGE RICHARDS & CO. LTD., however are unsurpassed for precision speed and adaptability. Continuous research and development keep RICHARDS borers way ahead of all others.

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STARLEY **86** GROUP



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Ransome and Marles produce these bearings in a comprehensive range of sizes and tolerances. The designs can include built-in preload which eliminates shims or adjustments on assembly. The bearing specification can

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engineers' layout and identification fluid



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\* Transparent only † Opaque only

## Prices

Transparent	Opaque
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Qt. 13/3	Qt. 16/6
Gall. 45/-	Gall. 55/-

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## SPECTRA COLOR SPRAY

in transparent blue only  
6 oz. aerosols 7/6

## SPECTRA COLOR REMOVER

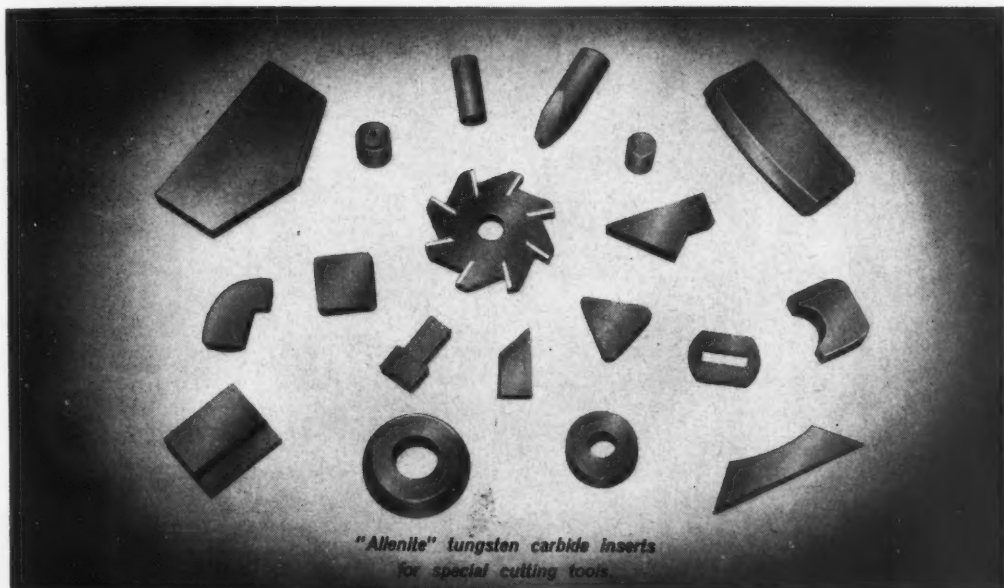
Pt. 4/9, Qt. 7/9, Gall. 19/3.

- Gives a thin durable film of solid even colour
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Tungsten Carbide

Tipped Tools and Tips

The research which Edgar Allen have put into their manufacture of Stag "Allenite" tungsten carbide cutting materials, including the addition of special elements to modify and improve their characteristics, has resulted in a range which gives outstanding performances in high-speed production with long tool life between grinds.

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**EDGAR ALLEN & CO. LTD.**  
**IMPERIAL STEEL WORKS SHEFFIELD 9**

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**"Allenite"**

**FLOWRAKE and  
FLOWCAST Tools**



**FLOWRAKE**  
for planing steel

Users everywhere report exceptional performances with this special shape of Allenite tipped tool, developed expressly for planing steel. Particularly successful with intermittent cutting so often encountered in this class of machining.



**FLOWCAST**  
for planing cast iron

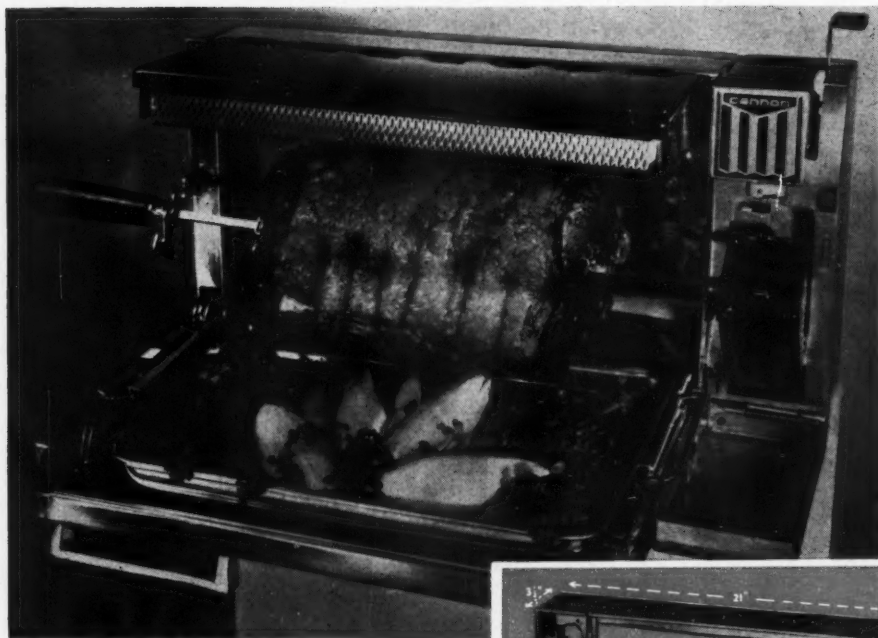
The success of Flowrake tools in planing steel led to a demand for similar tools for planing cast iron. Flowcast tools will stand up better than any in planing cast iron, especially with interrupted cutting or on machines not in the best of condition.

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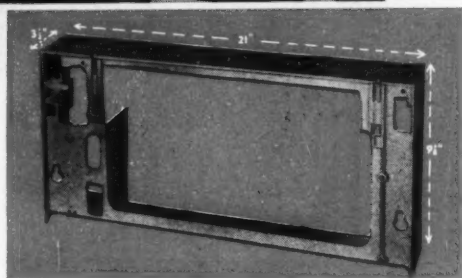
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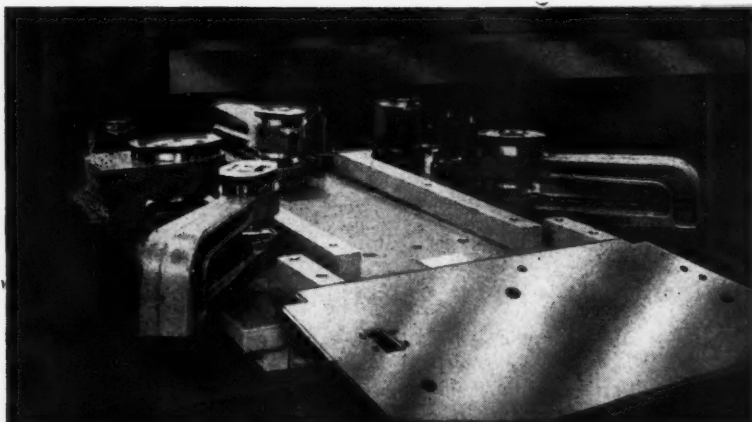
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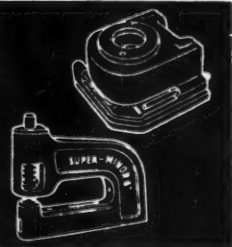
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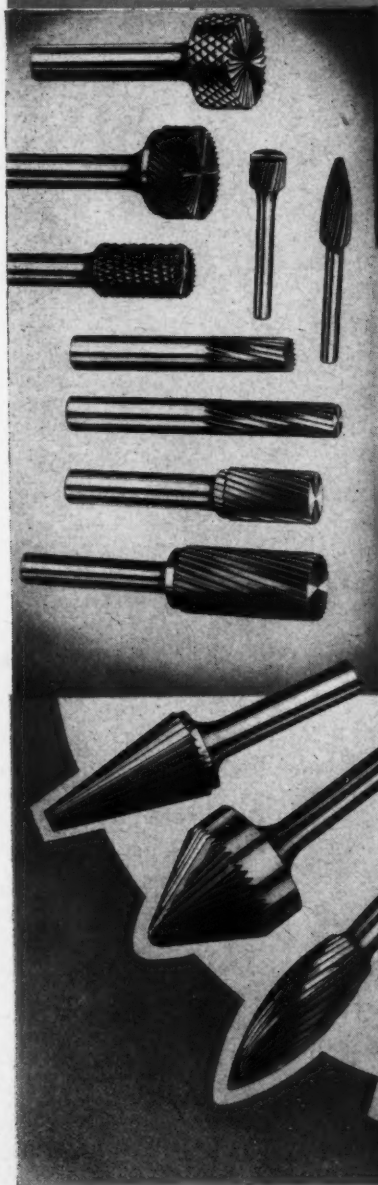
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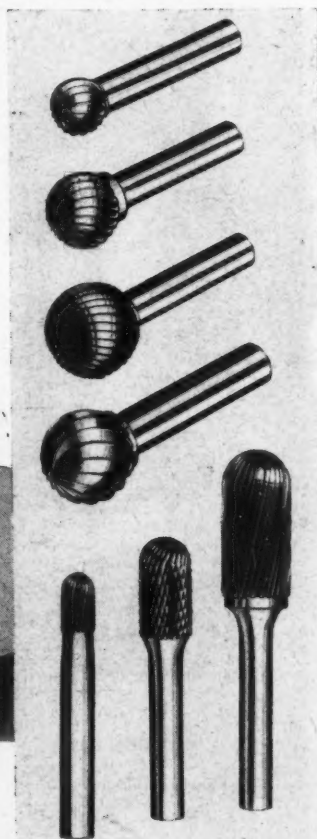
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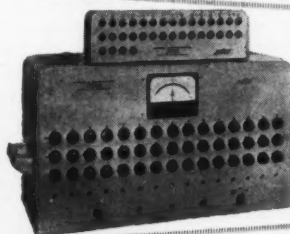
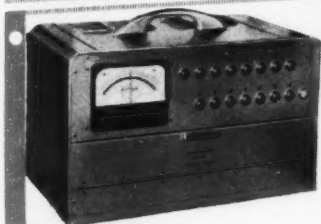
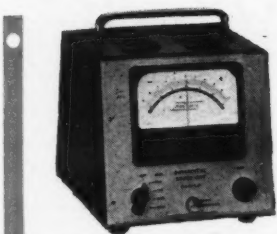
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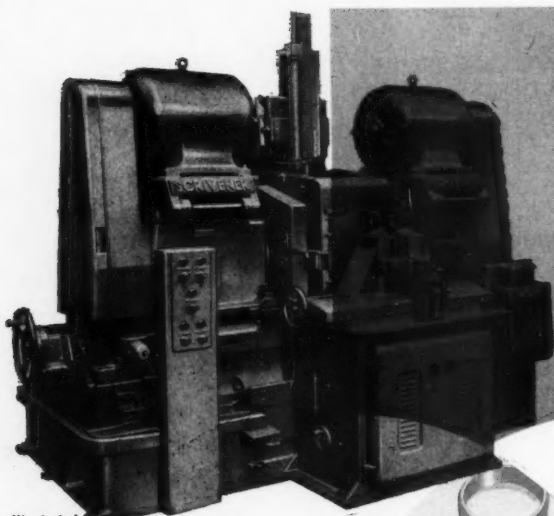
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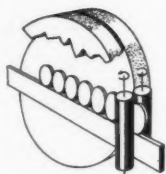


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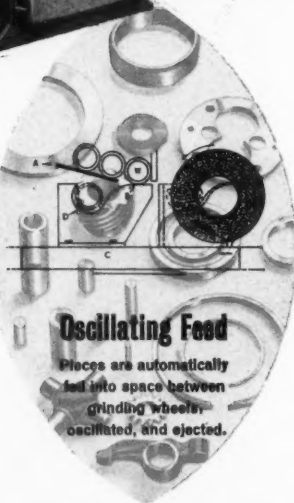
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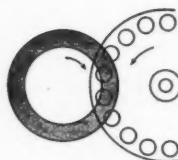
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# MACHINERY

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Vol. 99, No. 2549

September 20, 1961



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## Abstracts of Principal Articles

### VEB Carl Zeiss, Jena . . . . . P. 652

This article, which is the first of a series concerned with the East German organization of VEB Carl Zeiss, Jena, gives a brief history of the company, which was founded in 1846, and of the Zeiss Foundation. Established by Ernst Abbe, in 1891, the terms of this Foundation transferred the entire company to those who were active in the creation, maintenance, and expansion of the undertaking, and laid down conditions which were far in advance of ideas prevailing at that time. A review of the organization as it exists today is followed by a section on the hours, wages and conditions of work, which have been changed remarkably little by the coming of communism. One of the difficulties which the organization has always faced is associated with the multiplicity of instrument designs produced—now numbering more than 2,000, with several hundred thousand different parts. For this reason, the Mitrofanov method has been introduced, for the purpose of standardizing, as far as possible, the designs of similar parts, and has proved very successful. Where a wide variety of different parts must be produced, the cost of the necessary jigs and fixtures may also be very substantial and a standardized system has been introduced to enable economies to be made in this connection also. (MACHINERY, 99—20/9/61.)

### Making Components for Kopp Variable-speed Units . . . . . P. 662

In this second article concerned with the practice at the works of Allspeeds, Ltd., examples are given of milling operations on iris plates and end covers. Extensive use is made of "combined operations" on capstan lathes, whereby, with the aid of special attachments, milling, transverse drilling and tapping, also taper-turning, are carried out, in addition to the conventional machining normally performed on such lathes. With this practice, the number of different set-ups is reduced and productivity is increased. Finally, attention is drawn to the methods employed for producing a digital counter housing incorporating a Perspex window. (MACHINERY, 99—20/9/61.)

### The Production of Printed Circuits and Industrial Nameplates . . . . . P. 670

In this second article, concerned with the methods employed by Millett, Levens (Engravers), Ltd., and their subsidiary company, Printed Circuits, Ltd., fully-automatic plant, of advanced design, for etching

and dye anodizing, is described. Both installations, provide for automatic programming, and in the etching plant, three different materials can be processed simultaneously, on a selective basis. Reference is made to the procedure adopted in the "tooling" section, for the various cutting, blanking, piercing and drilling operations on circuit-boards and metal nameplates, that follow processing. The preparation of drilling templates, and piercing and blanking tools, is facilitated by the use of an etched-replica technique, based on printed-circuit methods, which eliminates marking-out. For certain piercing and blanking operations on circuits, it is necessary to heat the work, and for this purpose, use is made of infra-red lamps. Inspection of the finished circuits is facilitated, where possible, by the use of light-boxes, and simple electrical test rigs. (MACHINERY, 99—20/9/61.)

### Developments in the Forging of Materials for Service at High Temperatures . . P. 687

Investigations have been carried out by the Wyman-Gordon Co., U.S.A., in connection with the forging of high-temperature metals and alloys. Die wear is greatest with the refractory metals, some of which are now being forged experimentally at temperatures in excess of 2,500 deg. F. Dies used for iron- and nickel-base alloy forgings do not normally exhibit excessive wear. In order to obtain satisfactory forgings, melting of the metal must be carefully controlled, and vacuum melting is widely employed. Close control of temperature is necessary when forging nickel-base superalloys. Graphite lubricants have been the subject of much study, and some recently developed compounds have additives which produce an atmosphere that assists interlaminar absorption of oxygen and thus reduce friction. (MACHINERY, 99—20/9/61.)

### Index to Exhibits at the 7th European Machine Tool Exhibition Described on pages 679—685 of this Issue

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### Contributions to MACHINERY

If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

## The Advantages of Vibratory Finishing

During recent years there have been important advances as regards the speed, accuracy, and economy with which components of all types can be machined. Regardless of the quality achieved, however, it is frequently necessary to perform supplementary operations which do not come within the scope of normal machining processes, and these operations can add disproportionately to the total costs of production unless they can be carried out in an equally efficient manner. It is often essential, for example, that the sharp edges and burrs resulting from machining should be removed before parts go into service or are subjected to further processing, and at one time such work was commonly performed by hand. Similarly, it may be desired to remove tool marks from surfaces and to obtain smooth, polished, or burnished finishes, to provide greater fatigue resistance or improve appearance, and for such purposes, also, many parts were formerly handled individually on grinding or buffing wheels of various types.

As a result of developments in finishing processes, however, improved surface quality, edge rounding, and burr removal can now be achieved on a wide variety of workpieces at comparatively low cost. Attention may be drawn, for instance, to the progress that has been made in connection with shot blasting, wire brushing, vapour blasting, and electro-polishing. For many purposes, moreover, barrel finishing and certain similar processes have proved particularly effective. With these processes, as is well known, the required action is obtained as a result of random relative motion between the workpieces and the medium in the presence of water and a suitable compound. It might be thought that the effects produced would be too indiscriminate at least to enable precision parts to be treated without damage. In practice, however, it is found that with a suitable combination of conditions from the very wide choice available, remarkably close control can be maintained. It is also possible to provide fixtures to ensure the separation of components that might be damaged by mutual contact.

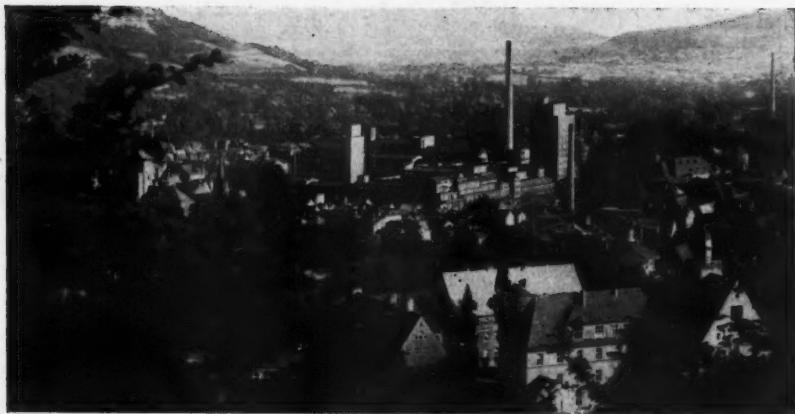
Hitherto it has been usual to impart the essential relative movement by rotating a barrel in which the charge of work and medium is contained, with the result that repeated sliding occurs as the mass is carried upwards. For some more specialized applications, however, the work is reciprocated in

the medium which remains stationary. More recently, good results have been reported from the use of equipment in which the motion is obtained by imparting vibration to the container. With one design, an open, upright container is employed, which can be tilted for discharging the contents, and there is provision for regulating both the amplitude and frequency of vibration in order to control the action on the work and thus enable the desired effects to be achieved.

One advantage claimed for the method is the rapidity with which the treatment is carried out, and this speed of action is said to be due to the repeated accelerations imparted to the workpieces and medium, and changes in direction of relative motion, with the result that a gyratory scrubbing action is exerted simultaneously on the surfaces of all the pieces. It is also stated that the constant vibration produces in the charge a condition of partial weightlessness which is of assistance in enabling delicate and fragile parts to be treated without damage. Another characteristic of the process is that internal or shrouded surfaces, provided that they are accessible to the barrelling chips or other constituents of the charge are treated as effectively as external areas. In one instance it is reported, a test was carried out to determine the feasibility of removing scale from the interiors of metal bulbs by vibratory treatment. These bulbs were  $3\frac{1}{4}$  in. long by  $\frac{1}{2}$  in. diameter, with a neck opening of  $\frac{3}{8}$  in. diameter by  $\frac{1}{2}$  in. long, and it is stated that a very satisfactory internal finish was obtained after treatment for 25 min.

As in the case of barrel finishing, larger parts can be held in fixtures for treatment by the vibratory method, with the added advantage that the action is accelerated. If the fixture is supported on the stationary frame of the machine, or externally, the normal processing time, it is claimed, is reduced by 50 per cent. If, however, the fixture is attached to the rim of the vibrating container there is a further time saving of 50 per cent because of the effects of separate additive vibrations. This rapid action is of particular value when workpieces of stainless steel, titanium, and other hard metals are to be processed. As examples of results reported, the following may be noted. On forged and machined turbine blades of unusually hard stainless steel, micro-inch readings for surface finish are reduced by 100 with a treatment period

(Continued on page 697)



## VEB Carl Zeiss, Jena

### History, Organization, and Standardization Methods Employed

By R. E. GREEN, Associate Editor

THE NATIONALLY-OWNED ORGANIZATION known as VEB Carl Zeiss still has headquarters in the place of its foundation—the small university town of Jena in Thuringia, East Germany. Carl Zeiss, the founder of the enterprise, was born in 1816 in Weimar, and in 1846 he set up a small workshop in Jena to make and repair instruments for the university. The majority of these instruments were simple and compound microscopes which were then made largely by trial and error methods, and the small firm made considerable—if irregular—progress, and moved to larger premises in 1857.

By 1866 the firm had produced a total of 1,000 microscopes and at about that time Zeiss was joined by Ernst Abbe who was then 26 and had gained his Ph.D., at Goettingen. During the next seven years a further 1,000 microscopes were produced and during this period the scientific principles involved in lens design were established, so that microscopes could be constructed according to mathematical data supplied by the designer, and trial and error avoided. Production and research continued, and by 1876 the number of employees had increased to more than 50. In 1880 the firm acquired an extensive site on the outskirts of the town where a new factory was built. This factory,

it may be noted, is now well within the town, the number of inhabitants having risen from about 20,000 in 1900 to 90,000 today.

Experimental work concerned with the making of various types of glass having different properties was carried out by Otto Schott in conjunction with Abbe at about this time, and resulted in the establishment of the Schott glass works in 1884, which supplied the Zeiss company with special types of glass. The Zeiss works then began to produce other optical equipment designed to extend the field of microscopy, and photographic lenses of the anastigmat type were introduced in 1890, under the name Protar. Further development led to the design of the Tessar lens in 1902, and by 1909 the company had established such a commanding position in the camera lens field that several large companies in Germany were forced to collaborate in efforts to compete with the virtual monopoly which had been created.

For nearly 30 years, Zeiss was the sole proprietor, but Abbe was taken into partnership in 1875, and his own son Roderich in 1881. Zeiss died in 1888, and his son retired in the following year, as a result of disagreements with Abbe, who was left in sole charge of the business.

### THE CARL ZEISS FOUNDATION

In 1889, Abbe set up the famous Carl Zeiss Foundation, to which his interests in the firm, also his rights in the Schott concern, together with those of Roderich Zeiss, were transferred in 1891. This Foundation provided, among other things, that the establishment should be owned by all those active in its creation, maintenance, and expansion, in concert. A complete scheme of administration was laid down, which embraced such "modern" ideas as profit-sharing, and insurance against old age and illness. Under the provisions of the Foundation, the wages of Zeiss workers could not be lowered after one year of service, only raised, and the discharge of a worker required the payment of specified compensation. This compensation amounted to six months' pay after three years of service, and it was stipulated that after five years of service the worker must receive at least a quarter of the amount which would have been due as a pension.

These provisions were designed to discourage unconsidered engagement of labour and arbitrary dismissals, but they had an adverse effect on the company after the first world war when, on account of discharges it was necessary to pay out some £100,000. The Foundation also laid down that wages were to be made up of three parts, comprising a fixed, non-reducible, portion, on which the amount of the pension was based; a supplementary portion, earned on the basis of piece-work or merit; and a variable portion based on the annual profits. Another provision was that the salaries of staff members, who did not receive the bonus, should be limited to not more than 10 times the average yearly wage of workers above the age of 24 and with at least three years of service.

Between 1896 and 1902, the bonus amounted to between 5 and 10 per cent of the yearly earnings, but trading difficulties in 1903 resulted in a loss. Workers had come to depend on the bonus, however, so that it was necessary to make advances to those who were in difficulties. At the same time, a co-operative credit supply association was started. In later years, the remaining part of the Schott works was handed over to the Foundation, and the administration of the organization has since remained largely unchanged.

In addition, the Carl Zeiss Foundation of Jena has contributed considerable sums for social and cultural purposes, and pays old age and disability pensions to ex-employees of the Zeiss organization which amounted in 1960, for instance, to 3 million marks (about £275,000).

At the beginning of this century, the range of products was extended to cover opto-physical

measuring instruments, telescopes, field glasses, periscopes, and range-finders for military purposes, and in 1908 a range of surveying instruments, including theodolites and levels, was put into production. Point focus spectacle lenses were also introduced at this time, followed, in 1911, by various high-quality motor car spot and head lamps, powered at first by acetylene and later by electricity. In 1913, the need for more land was so great that the house occupied by Abbe and his family had to be pulled down and replaced by factory buildings, the price of adjacent land having risen considerably by this time.

The first world war resulted in an increase in the production of military equipment and a slowing down of development work. After the war, surplus capacity was devoted to the production of a range of precision measuring equipment including micrometers, comparators, and other gauges. In 1920 a toolmaker's microscope was introduced, and was followed by the Optimeter comparator, capable of measuring to 0.001 mm. (0.00004 in.); internal and external measuring machines; screw and gear checking equipment; a thread measuring unit; and an interference comparator for the absolute length measurement of gauge blocks. This latter instrument was based on research at the Institute of Weights and Measures, and was marketed by the independent firm of Schuchardt & Schütte, Berlin.

During the years between the wars, there was a gradual recovery, although great difficulties were experienced during the main period of depression, when the number of employees was reduced to 3,200. By 1939, the number had risen again to 12,000, and the works were almost fully engaged in the production of military equipment, although an extensive research programme was in operation. At the end of the war, the area was occupied by American troops for a period of about three months, and during that time some 200 scientists and technicians left Jena and went to Oberkochen, in Western Germany, where the Carl Zeiss Foundation established a factory for them under the name *Opton*.

When the Americans left, the Russians occupied the area, and manufacturing operations were allowed to continue for about 16 months, before the major part of the equipment was dismantled and sent to Russia as reparations. These dismantling operations occupied some 6 months, and were completed towards the end of March, 1947. The organization was then left largely to itself to obtain other machines from factories elsewhere in the German Democratic Republic, to buy new machines where possible, and to build equipment for specialized purposes. By 1949, the number



of employees had risen to about 10,000, and a programme of research, development and manufacturing had been launched, covering such products as microscopes; opto-physical measuring instruments; industrial fine-limit measuring equipment; astronomical apparatus; binoculars and telescopes; instruments for surveying, photogrammetry and ophthalmology; photographic lenses and projectors; and spectacle lenses and frames.

During the following years, this programme was rapidly and continuously extended, and there was an increase in the number employed to about 18,600, and a rise in total production to four times the 1949 figure.

#### **THE ZEISS ORGANIZATION TODAY**

At the present time, the Zeiss organization is still largely autonomous, although it is required to co-ordinate its planned programmes of production with those of other factories engaged in similar activities and with the Government planning authorities. Direction of the affairs of the enterprise is undertaken by a board of management which includes directors concerned broadly with technical, commercial, research and personnel matters. Advice relating to prices and economic questions in general is given by a small group which includes the chief accountant. A second group, responsible directly to the board, comprises directors of technology, production, quality control, research and development, planning, personnel, economics, and home and export sales.

The main factory of the organization, which has an estimated floor area of about 2,690,000 sq. ft., is still in the centre of Jena and is seen in the heading illustration. This factory is the largest, and here the majority of the Zeiss workers, numbering some 13,000, are employed. Most of the buildings are of several stories—usually five or six—and there is also a 14-storey office block, which was built in 1935-1936. A new block, of 16 stories, in which research activities will be concentrated, is at present under construction, and will be staffed by some 300 scientists and engineers. The block will provide approximately 215 sq. ft. of floor space per worker, and there will be sufficient space to enable the staff to be increased to 500 eventually.

In addition, there are two other factories in Jena, known as the North and the South Works, the former being employed mainly for warehousing purposes. In the South Works, to which further reference will be made later, the heaviest machining operations are undertaken, and astronomical telescopes and other equipment are built,

the number of employees being about 3,200. The Zeiss Foundation specifies that the main works must be located in Jena, but several branch factories have been established in surrounding towns, mainly to take advantage of labour supplies.

These factories include a medium-sized establishment at Saalfeld, about 24 miles from Jena by road, where some 1,500 people are employed, of whom 60 to 65 per cent are women. Like the main works, this factory was completely stripped by the Russians—even the lifts and parquet flooring were removed, and even now it is not in full operation, as flooring and special machines have still to be installed in certain shops. Additional equipment to be provided will include turret punch presses, lathes, and milling machines arranged for programme control. At present, the factory produces photo-electric cells and photo-multiplier tubes in a range of types and sizes, some with quartz end covers fused to the glass envelopes, also photographic lenses, medical instruments, secondary electron multipliers, radiation detectors, and image converters.

The Saalfeld factory also builds industrial electronic computers, developed from a relay-operated design. Each computer has 7,500 ring-shaped ferrite cores made from a mixture of zinc and aluminium oxides, with iron powder. These cores are wound with coils designed to produce specific electrical characteristics, and are assembled by hand into boards, each containing several hundreds, of which the computer is made up. The completed unit has a memory drum and plug-in circuit-selection panels, and operates on instructions provided by punched cards.

Other Zeiss factories include the WERRA camera works at Eisfeld, near the border with Western Germany, which will form the subject of a later article. At this factory there are about 500 employees, and an output of some 50,000 cameras per year is maintained. Other products include small compression ignition engines for model ships, aircraft and cars, 35-mm. slide projectors, and sub-assemblies for 35-mm. sound film projectors. In another factory, at Dresden, 400 people are engaged almost entirely in the production of optical components for cameras, which are supplied to various factories in the city, where the East German camera industry is now concentrated.

#### **DIVISIONS OF THE ZEISS ORGANIZATION**

The Zeiss organization comprises 17 separate divisions, most of which share the same buildings and often the same facilities such as drawing offices and machine shops. In the main works, additions made over the years, coupled with the restoration



of war damage, has resulted in a labyrinthine layout, with the various shops at different levels connected by corridors, lifts, and stairways. The sharing of facilities means that components must often be transported for long distances between operations, especially those of a specialized nature, and these difficulties, it appears, must inevitably raise production costs and increase the total amount of work in progress at any one time.

Generally speaking, Zeiss products, of which there are rather more than 2,000 at present, are made in small batches, 70 per cent of the items being produced in lots of less than 200. Obvious exceptions include binoculars and cameras, for which flow methods are employed. In these circumstances, production methods are necessarily largely conventional, and special machines are only used for operations which cannot be satisfactorily performed on standard types. Efforts are being made, however, to rationalize the range of products and to standardize components, to enable a single design of theodolite housing, for instance, to be used for several different types of instrument. Further reference to this subject will be made later.

Among the major divisions of the organization may be noted those concerned with microscopes and opto-physical measuring instruments, including nucleonic measuring equipment; instruments for surveying and industrial precision measurement; photographic lenses for still, cine, aerial, television and process cameras, and projectors; photogrammetrical and astronomical instruments; electrical and electronic equipment; lens grinding and optical products; spectacle lenses of all kinds, including plain, bi-focal, contact, and sun-protection types; special assemblies and components such as oscillators, photo-electric cells and crystals; design and development of special machine tools for the various divisions; the making of precision parts for telescopes; light alloy castings and pressure die castings; and wood and leather cases of all kinds.

#### **HOURS, WAGES AND CONDITIONS OF WORKS**

The Zeiss organization was among the first in Germany to adopt the 8-hour working day when, in 1900, a referendum was taken among the employees as to whether they could produce in eight hours as much as in the nine hours previously worked. Today, all the employees, almost without exception, work from 7.30 a.m. to 4 p.m., with a 30-min. break for lunch, and from 7.30 to 12.30 on Saturday, representing a 45-hour week. Overtime is avoided where possible, but when it is necessary, the payment is 15, 25, 50 and 100 per cent extra on normal days, Sundays, national holidays and religious festivals, respectively.

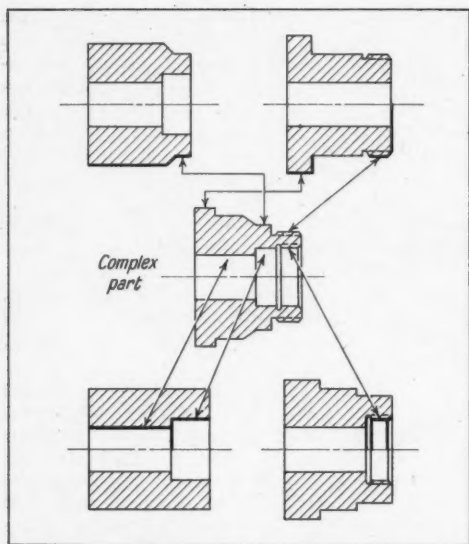
Average rate of wages paid in the organization is about 440 East marks per calendar month, which is equal to about £40 sterling at the current exchange rate of 11 marks to the £1. It is impossible to generalize about payments however, since there is a system whereby the rate may be changed to enable skill or extra qualifications to be rewarded. With this system, workers are placed in one of eight grades. Those in grades (1) to (4) are unqualified, and the remainder have qualifications of various standards. For the unqualified, educational and vocational training is freely available in a spare-time school provided by the organization, which has a current enrolment of some 6,000 people, who are studying a very wide range of subjects.

The factory also operates an extensive apprentice training school with places for 1,000 boys, who attend classes for two days for every four days spent on practical work during the first two years of their training. Such boys will normally have had 10 to 12 years of school studies, and after completing the full time course they work in the shops for a further year before entering grade (5) of the wage scale. With the acquisition of greater skill, and by continuing to study in the evenings, an ex-apprentice can reach the highest grade which is paid at the rate of 900 marks (£81.8) per month.

Trained engineers start at a salary of 640 to 780 marks (£58.1 to £71.3), according to their qualifications, and can normally rise to 1,550 marks (£141) per month. The number of women workers in the enterprise is about 6,700, or 36 per cent of the total, and almost all of them are employed on production or in the offices, very few being concerned with administration.

By law, every Zeiss worker is entitled to 12 paid working days holiday per year, irrespective of length of service, and after a few years this period may be extended up to a maximum of 18 days. Foremen and administrative staff have slightly longer holidays, and more time may also be given to those engaged on particularly arduous tasks or work involving the use of poisonous substances. In theory, each worker can choose the time for his or her holidays, but the factory naturally prefers that they should be spread over as much of the year as possible. Holiday homes are provided by the organization in the Thuringian forests and on the Baltic coast, at which limited numbers of workers, ranging from 24 to 100 at a time, can be accommodated at extremely low rates, for instance 35 marks (£3.2) for 14 days with full board.

There are also children's holiday camps in which the children of Zeiss workers are accommodated in tents. Sports are encouraged, and facilities,



**Fig. 1.** To arrive at the "complex" part employed in the Mitrofanov rationalization method, drawings of similar parts on transparent paper are superimposed. Here, the complex part is seen at the centre with simpler parts above and below

towards the cost of which each worker contributes 1.3 marks (2s. 3d.) per month, are afforded on a generous scale. Many other amenities are provided by the organization, including a hospital, kindergartens, crèches and day nurseries for children, canteens, hostels, and convalescent homes. In addition, substantial support is given to educational establishments in Jena, and particularly to the university, many members of which have access to Zeiss research facilities.

#### **RATIONALIZATION OF COMPONENTS AND MACHINING SET-UPS**

As in most large organizations, departments engaged in the design and production of various items tend to operate independently, and their products incorporate components designed specifically to suit the applications. Even where a single department is concerned with a range of somewhat similar products, the designers often treat each design individually, without considering what existing parts, if any, might be used in the new product. This problem is well known, and a number of different solutions has been put forward from time to time. Most of these solutions involve

efforts to re-design components to suit more than one application, in order to reduce the total number of different parts involved, and enable those parts to be produced in larger batches, with consequent savings in costs.

During recent years, a Russian engineer named S.P. Mitrofanov has been very active in advocating, by means of lectures, articles, and books the adoption of a form of rationalization of machining set-ups which he has evolved.

In 1958, VEB Carl Zeiss decided to carry out an investigation into the possibilities of rationalization by the methods laid down by Mitrofanov. One of the aspects covered by this investigation was concerned with the numbers in which different products were made, and it was found that for some 32 per cent of the total, the outputs ranged from 1 to 50 per year. About 68 per cent of all products are required at rates of less than 200 per year, and only 0.6 per cent, at rates between 5,000 and 10,000 per year. Since many Zeiss parts closely resembled each other, it was obvious that there was considerable scope for rationalization, and the Mitrofanov method was adopted towards the end of 1959.

#### **THE MITROFANOV METHOD**

With the Mitrofanov method, workpieces are first classified in accordance with the machining or other processes principally involved in their production, for example turning, milling, drilling, grinding, and boring. It is then possible to select groups of parts from the various classifications which present similarities as regards both design and machining. The object is to ensure that the parts in a group can be wholly or partly machined with the same basic set-up, which can be readily modified to meet the individual differences.

To this end, a characteristic part is selected or specially designed so that it incorporates all the features required for all the other parts within the group. In arriving at the form of the characteristic or "complex" part, as it is termed, it is found convenient to prepare drawings of the various parts which will constitute the Mitrofanov group, on transparent paper. These drawings are then superimposed one on another for the purpose of building up the "complex" design. As a simple example, four components from such a group are shown in Fig. 1 with the "complex" part in the centre, and it will be evident that if a lathe set-up is arranged for producing the "complex" part, it can also be employed for the other parts by merely removing certain tools and/or eliminating operation stages. Obviously it is desirable that the components selected to form a

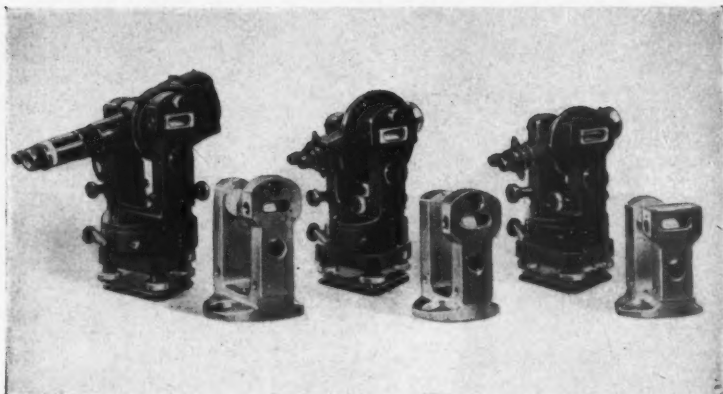
group should have as many dimensions in common as possible, and it may sometimes be feasible to introduce minor modifications in individual designs, with this end in view. It will be understood that the operations list drawn up for the "complex" part suffices for all the components in the group, it being only necessary to delete the operations that are not needed for any particular item.

The idea of producing two or more different parts, or modifications of the same part, by means of a common set-up on a machine or machining line is not, of course, new, and this procedure has, for example, been followed in connection with 4- and 6-cylinder engine blocks of the same bore size. With the Mitrofanov system, however, this practice is extended by systematically selecting parts which lend themselves to such treatment.

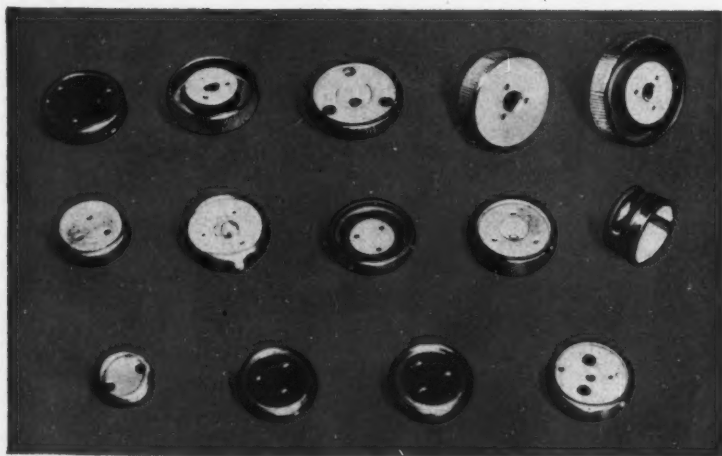
Mention may also be made of a somewhat specialized application of the method which is based on the use of standard cams for the pro-

duction of groups of ring-shaped parts, for instance, on automatics. Here again, the novelty lies not so much in the principle as in the extent of its application on the basis of systematic component classification. It is stated that it has already been found possible to provide common cams to cover the requirements of groups of 20 and 40 ring-shaped parts, and that another cam suffices for 40 parts described as "funnel shaped."

Very striking results can sometimes be achieved when the Mitrofanov system is adopted in conjunction with a programme of orthodox simplification. Thus, it is reported that as a result of careful classification it was found possible to reduce a total number of knurled-edged knobs, estimated at between 60,000 and 80,000, to the 14 shown in Fig. 2, which form a Mitrofanov group. It is emphasized, however, that the method enables good results to be obtained rapidly even where it is not practicable to reduce a wide variety of similar forms to a narrow range.



**Fig. 3.** Similar parts for a range of surveying instrument assemblies have now been combined by means of the Mitrofanov method, so that a single design suffices for a number of different instruments



**Fig. 2.** Some 60,000 to 80,000 different knurled knobs, formerly employed on various Zeiss instruments, have been reduced to a total of 14 designs, as here shown, all of which can be produced with common machine set-ups



**Fig. 4.** These lens mountings provide examples of parts of similar shape, which can be produced on a common flow-line basis by the Mitrofanov system

Particularly large savings can be achieved where it is possible to establish a flow line for a group of parts which can be kept in continuous operation. Such a line has been provided for the production of five different supports, generally similar to those shown in Fig. 3, for geodetic instruments. Moreover, 15 other parts are also handled on this line. Mention may also be made of a production line for the seven different tubular mounts shown in Fig. 4, for photographic objective lenses. Other projects on which work is now being carried out include a flow line for the production of a variety of gears.

A central Mitrofanov office has been set up, which is now staffed by some 15 engineers, who are responsible for the grouping of existing parts for production with common set-ups on machines, or on flow lines. In addition, drawings of all proposed new parts are submitted to this office to ascertain whether they conveniently fall within—or can readily be adapted to fall within—existing Mitrofanov groups. Efforts are also being

made to persuade designers to take account of the forms of established "complex" parts, so that fresh components can be machined, where possible, with the common set-ups.

Application of the Mitrofanov system to various parts which are made as aluminium pressure die castings or from sheet material, it is pointed out may offer particular advantages, and in some instances, modifications to existing dies may be made to avoid the need for producing completely new

tools. It may also be noted that with this system, apart from the savings in manufacturing costs, the reduction in planning times may enable new parts to be introduced much more rapidly.

Investigations into the possibilities of the new method were begun on a limited scale in 1959 but the work was rapidly expanded and it is stated that by October, 1960, an estimated saving of nearly 1 million marks (£91,000) had been



**Fig. 5.** To avoid the high and rising costs of jigs and fixtures for parts made in small batches, standardized building components are used, including faceplates, angle brackets, swivelling blocks, bolts, nuts, and dowel pins



achieved. It is anticipated, moreover, that additional annual savings of about 600,000 marks (£54,500) will be obtained as a result of the work undertaken this year, and in each of the next two or three years. At the end of that time, the system should be in full operation.

#### STANDARDIZED JIG AND FIXTURE SYSTEM

High costs in small batch production also result from the need for individual jigs and fixtures for machining operations on large numbers of different parts. A reduction in these fixture costs has been achieved by the adoption of a so-called unit construction system which enables temporary jigs and fixtures to be built up very easily and quickly. When the work for which a fixture was made up has been completed, it is dismantled and the parts are stored until they are required for use in another fixture. Typical parts for jig and fixture construction are seen in Fig. 5, and they may be used in connection with most conventional machining operations such as drilling, tapping, milling and grinding.

The complete set of fixture parts employed in the Zeiss works is illustrated and described in a small booklet, copies of which were circulated to all departments likely to find the system useful, when it was introduced in 1957. The parts include faceplates with diameters from 6.3 to 31.5 in., in thicknesses from 0.86 to 1.8 in., with various numbers of threaded holes arranged at different spacings. These faceplates are also made with grooved and with T-slotted central portions, to facilitate accurate location of other elements such as angle plates, which are also provided with patterns of threaded holes.

Other items include flat square and rectangular plates, also with patterns of threaded holes, clamping plates, bush holders, V-blocks, swivelling brackets, and special hardened bolts, nuts, washers and locating pins. In those machine shops in which the system is to be used very frequently, an area is set aside for storage of the elements, as

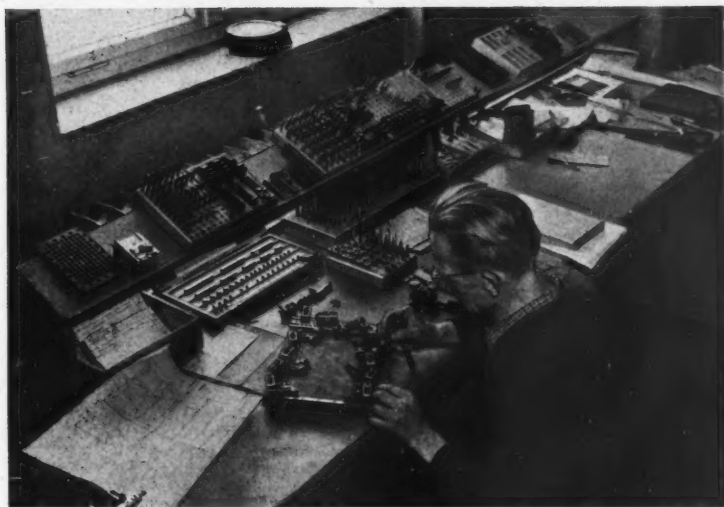


Fig. 6. In each department, area or factory where the method is to be used, space is set aside for the storage of the fixture building parts, and benches are provided for assembly

seen in Fig. 6, and one or more skilled men are employed specifically for building up the fixtures required. Such fixtures are "designed" on the spot, by the builder, who assesses the work to be performed from the drawing, and decides on the best construction for the jig or fixture.

Various methods of building are adopted, depending on the shape of the part, the operations to be carried out, and the degree of accuracy required. For some work, fixtures may be assembled with the aid of simple measuring tools, but in other instances the use of gauge blocks may be necessary. Each building element has one or more accurately-machined plain bores into which locating buttons may be inserted to facilitate positioning the various parts of a fixture. In Fig. 6, the builder is seen finishing the assembly of a simple drilling jig for producing 11 holes of 0.13 to 0.169 in. diameter near the edges of a flat rectangular plate.

The completed jig is seen in Fig. 7, and it incorporates a rectangular plate from the standard equipment, as a base. Support pieces with rebated edges are bolted to this plate and they serve both to hold the component clear so that the drills do not penetrate into the base, and to locate the part by three of its edges. The fourth edge of the jig, at the right, is fitted with a removable clamping element, held by two of the standard bolts men-



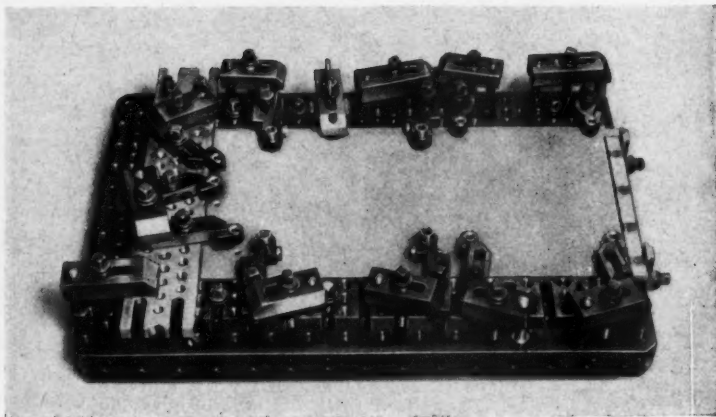


Fig. 7. A close-up view of the drill jig seen in course of construction in Fig. 4, showing the rebated plates which hold the work to be drilled clear of the base plate, and the bush holders which can be fitted with bushes of different bore diameters

tioned above, which can be released for loading and unloading. On top of the rebated support pieces are bolted bush holders, with slotted necks in which can be clamped standard bushes having bores to suit the diameters of the holes to be drilled.

A simple jig such as that illustrated is built in about three hours, and it is immediately dismantled when the operations have been completed. No records of the method of construction are kept, mainly because of the simplicity of the system and because there are so many different applications that record-keeping would be very costly. The system is generally confined to the making of fixtures for batches of parts of less than about 200, special fixtures usually being made where the numbers of parts are larger.

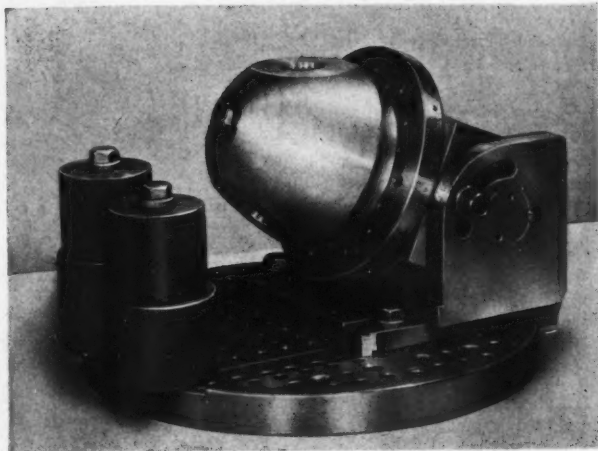
For building fixtures on circular faceplates, particularly where they are to be used on lathes or grinding machines, a pedestal carrying a circular flat plate is provided, as seen in Fig. 8. On this plate is mounted a base carrying two brackets with bearings for a shaft, to the end of which the faceplate can be attached. With this arrangement, the faceplate can be turned to suit the builder's convenience, and fitted with balance weights if necessary. Other examples of faceplate type fixtures are seen on the bench in the foreground in Fig. 8, and an interesting example, which indicates the versatility of the system, is shown in Fig. 9.

Designed to enable holes on opposite sides of a sphere to be bored and spot-faced, this fixture incorporates a circular faceplate of the grooved type,

and an angle bracket is located by the sides of the grooves and bolted in position. This angle plate forms part of the standardized equipment, and has side pieces with accurately-bored holes which receive bearings for a swivelling block. The edges of the side pieces are marked with angular graduations to facilitate approximate setting to the required angle, greater accuracy being obtained with a sine bar. The swivelling block has a central bore to take the spigot of a smaller faceplate, of 6.7 in. diameter, with edge graduations all round.



Fig. 8. For building fixtures on faceplates this pedestal, fitted with brackets to carry a rotatable shaft, is provided. The faceplate can thus be turned, as required, and fitted with balance weights if necessary



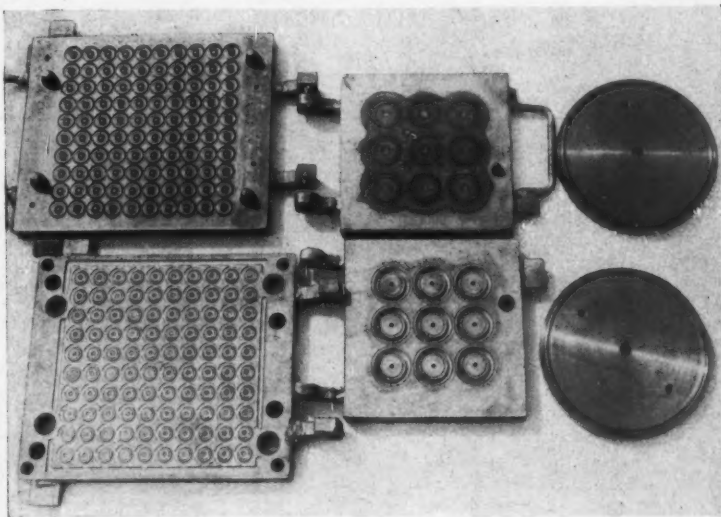
**Fig. 9.** Details of a faceplate type fixture, designed to hold a spherical component for boring and facing operations on opposite sides. It has been built with standard components from the Zeiss range

A central bolt or stud which passes through the bore of the component serves to secure it to the small faceplate, and the assembly is completed by suitable counterweights. In connection with many fixtures built from the standard components, difficulty is experienced in locating or holding the workpieces, and in such circumstances recourse is made to special parts which are produced on the spot, usually by the equipment builder. Such a part is commonly of simple form, and is labelled with the work-piece number so that it may be kept for re-use when the next batch of such workpieces is to be machined. The complete set of fixture-building equipment contains approximately 1,000 parts, and it is estimated that direct savings amounting to about £22,700 per year are being obtained from the use of one such set at present.

Other aspects of the works practice of the Zeiss organization will be discussed in subsequent articles.

### Ultrasonic Cleaning Treatment for Moulds

At the works of Plastic & Rubber Products Co., Los Angeles, California, U.S.A., good results are being obtained from the use of Sonogen ultrasonic cleaning equipment, for the treatment of moulds for rubber products, examples of which are shown in the figure. The process, it is stated, offers particular advantages for moulds used to produce O-rings and lip seals, and for plug type moulds with numerous pins and surfaces which are relatively inaccessible. Certain moulds are of the conventional "book" type, made from low carbon steel and sometimes plated. Others, for use on semi-automatic machines, are made to close limits of accuracy and usually have hardened, chromium plated cavities. For the latter, ultrasonic cleaning is of special value on account of the saving in time and by reason of the fact that risk of damaging the expensive tools is avoided. An alkaline base cleaner has proved most successful.



Examples of rubber moulds before (above) and after ultrasonic cleaning

## Making Components for Kopp Variable-speed Units

Some Further Examples of Set-ups and Equipment Employed by Allspeeds, Ltd., Clayton-le-Moors, Lancs.

By A. W. ASTROP, Associate Editor

A RECENTLY-ACQUIRED FACTORY is being employed almost exclusively for the quantity production of Kopp variable-speed units by Allspeeds, Ltd., Accrington, Lancs., the sole selling and manufacturing licencees in this country, and in an article in MACHINERY, 99/616—13/9/61, attention was drawn to some of the principal design features of the unit and to the methods whereby the main drive balls are machined. These balls are made at the rate of approximately 50,000 per year, to serve the needs of Allspeeds, Ltd., and of other licencees throughout the world, including America, and six different sizes—ranging from 1.000 to 3.242 in. diameter—are in continuous production. Limits for sphericity, diameter, and finish are very close. For example, the set of balls in a Kopp unit is required to be of the same diameter within 0.0001 in., and the surface finish must be between 1 and 2 micro-inches.

Mention was also made in the previous article of a component part of the Kopp unit known as the iris plate. This part incorporates three arcuate slots, which serve as cam faces for tilting the drive ball spindles in synchronism, to control the output speed of the unit. The set-up for milling these slots is shown in the close-up view Fig. 1, where a finished iris plate is indicated at A, with another, in a different position, adjacent to it. The three arcuate slots are clearly seen, and limits of  $\pm 0.001$  in. must be maintained on the radius to which each slot is milled, of  $\pm 0.00025$  in. on the width of the slot, and of  $\pm 0.001$  in. on the chordal length. Moreover, the distances from the ends of the slots to the periphery of the plate, and to the bore, are held to  $\pm 0.001$  in.

Such limits are not easily maintained at a small-diameter end-milling operation, and the difficulties are accentuated by the fact that the portion through which the slot requires to be milled is "bowed." As a result, the depth of cut is not continuously uniform and varying deflecting forces are imposed on the cutter. It will be noted that the centres about which the slots are machined are off-set from the bore of the plate, and the set-up

shown in Fig. 1 provides for this off-set, also for turning the work through the required number of degrees to suit the chordal length of each slot.

On a Victoria [B. Elliott (Machinery), Ltd.] type V 2 vertical milling machine is mounted a standard rotary table, to which motion is applied by means of the dividing plate and handle seen in the foreground. On this table, and off-set from the centre, is carried a special 3-position indexing fixture, as at B, to the top face of which can be secured interchangeable seatings to suit the various sizes of iris plates required. The centre of the rotary table is also off-set from the cutter spindle, and the 2-flute cutter is plunge-fed into the work to produce a starting hole. Subsequently, the rotary table is turned through the required number of degrees, to

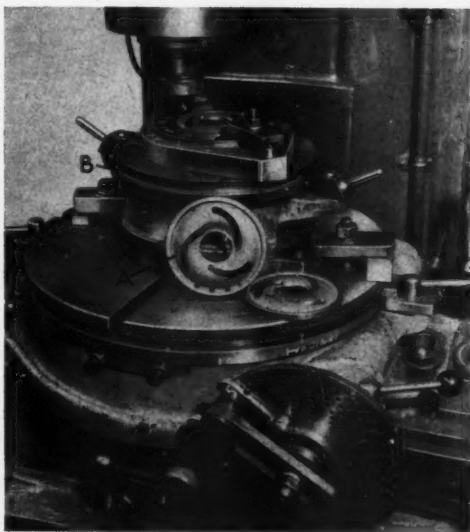
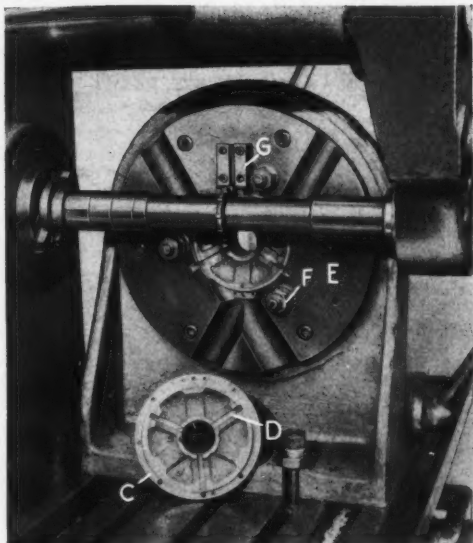


Fig. 1. Set-up on a Victoria vertical milling machine for producing the arcuate slots in iris plates for Kopp Variators



**Fig. 2.** Guide slots for the main drive ball spindles are plunge-milled at this set-up on an Archdale horizontal milling machine

mill the first slot. The rotation of the table is then reversed, and the cutter is withdrawn. Next, the indexing fixture is turned through 120 deg., and locked, and the procedure is repeated.

The extreme ends of the spindles for the main drive balls are guided in slots in the end covers of the unit, and these slots require to be milled accurately for size and angular spacing. The bottom of each slot must also be curved, in an arc which approximates to that described by the end of the ball spindle as it is tilted by the iris plate. These slots are machined truly radial to the longitudinal centre line of the unit, and an end cover for the smallest Kopp Variator, with the guide slots finish milled, is seen at C in Fig. 2. The three slots, as at D, are clearly visible, and another end cover is seen in position in the special work-holding fixture, in readiness for milling the third and final slot. Set up on the table of an Archdale horizontal milling machine, the work-holding fixture is of the angle-plate type, and has a large-diameter bore to receive the body portion E. The latter can be turned within the fixture and can be located at 120-deg. increments by means of a lever-operated plunger.

At the centre of the member E there is a seating to receive the workpiece, which is loaded from the side remote from the camera and is secured in position by clamps, tightened by means of the

nuts F. For angular location of the work there is a short dowel, which projects from the back of the member E and enters one of the previously-drilled holes in the flange. Screwed and dowelled to the member E is a setting block G, which incorporates a slot that is 0.020 in. wider than the cutter. When starting on a batch of components, the work-table is lowered to bring this block level with the cutter, and is moved to the left so that the block embraces the teeth. The cutter is then set transversely so that it is central with the slot, a 0.010-in. feeler being inserted at either side.

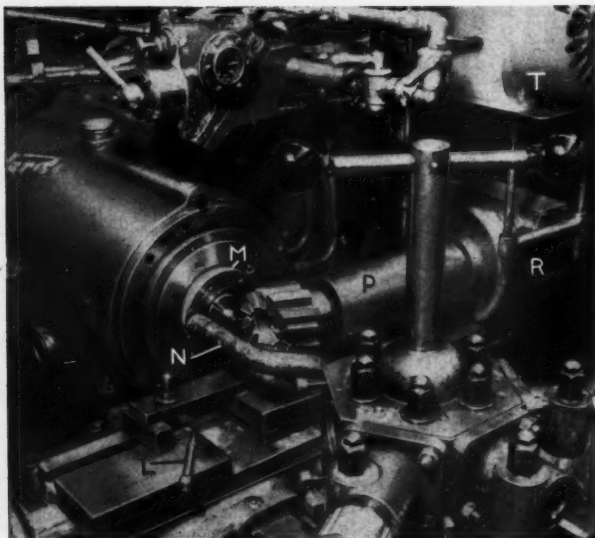
To machine the slots, the work-table is raised to a predetermined height and is moved to the left, under power, to plunge-feed the work on to the cutter. The table is fed to a dead-stop, which determines the depth to which the slot is machined, and is then retracted so that the member E can be indexed through 120 deg. to bring the work into position for machining the next slot. The member E is interchangeable with a number of others, with central seatings to suit the various sizes of iris plates which are required to be machined.

For milling the cam faces on drive cones, the set-up shown in Fig. 3, on a Fritz Werner horizontal machine (Rockwell Machine Tool Co., Ltd.), is employed. As described in the previous article, these cam faces serve to apply axial load to the drive cones during service, and to hold them in



**Fig. 3.** Cam faces on drive cones are milled in two passes with a 2-bank inclined-tooth milling cutter on a Fritz Werner machine





**Fig. 4.** Ward 2C capstan lathe with a special motor-driven milling attachment mounted in place of the rear tool-box. With this arrangement, main drive ball spindles are finished at one set-up

close contact with the main drive balls in the unit. A finish-milled drive cone is indicated at *H*, and the cam surfaces can be seen on the face which is uppermost. An unmilled cone is in position in the centre of the Fritz Werner indexing table *J*, where it is located by a special seating. It is locked in position by means of the clamp ring *K*, which is internally-threaded and is placed over the work and screwed down by hand. The bore of the ring *K* is stepped, to provide a shoulder which engages with the face of the work, but leaves the central portion—on which the cam faces are to be milled—exposed.

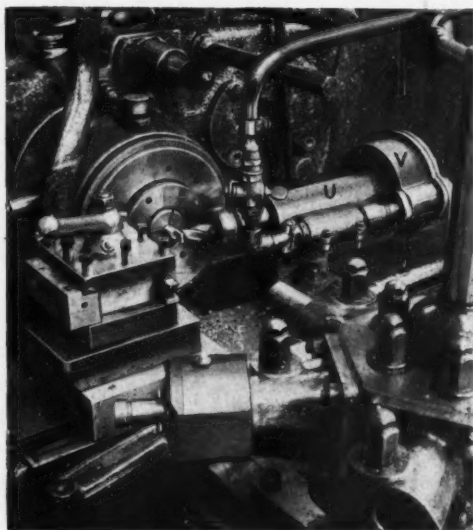
A double-flank McCrosky high-speed steel milling cutter (Geo. H. Alexander Machinery, Ltd.) is employed, which has staggered, inserted teeth, set at the required angle to produce the inclined cam faces. Two passes are made across the drive cone, which is indexed through 90 deg. after the first pass.

#### COMBINED OPERATIONS ON CAPSTAN LATHES

In the previous article, mentioned above, reference was made to "combined operations" on capstan lathes at the Royal Works. Such operations are carried out on a considerable scale, and

with the aid of special attachments, which have been designed and built by the company, milling, also transverse drilling and tapping, are performed at the same set-ups, in addition to the more conventional machining associated with capstan lathes. In consequence, significant savings in handling time have been obtained, and in consequence productivity has been increased.

A typical set-up of this kind is shown in the close-up view Fig. 4, where the machine is a Ward type 2C. This lathe is employed for producing the spindles for main drive balls, and a typical component is seen resting on the cross-slide, at *L*. There are various diameter steps on the spindle, and at the end nearer the camera there is a head portion on which two flats are required to be milled. At the first stage, conventional turning operations are carried out on the body of the spindle, and when these have been completed the part is removed from the air-operated collet, reversed end-for-end, and re-loaded.



**Fig. 5.** Another Ward machine is equipped with an air-driven milling spindle, as here shown, for operations on indicator shafts



This sequence has just been completed in Fig. 4, and it will be seen that the head portion of the spindle is projecting from the collet. In the face of the collet retaining ring *M* there are two small diameter holes, which are accurately diametrically-opposed, and these holes are engaged, successively by a conical pip which projects from the end of the curved bar *N*. This bar is secured to one face of the turret, and the latter is advanced to thrust the conical pip into one of the holes in the collet ring, as shown. With this arrangement, the spindle is located angularly, and is prevented from turning.

In place of the rear tool-post, on the cross-slide, there is a milling attachment, which comprises a spindle housing *P*, a worm and wheel reduction unit *R*, and a  $\frac{1}{2}$ -h.p. driving motor *T*. The motor is carried on a platform which is provided with four legs, arranged to pass through four bosses. These bosses are welded to the ends of two pieces of tube, and the latter are secured horizontally, to each side of the worm unit *R*. Means are provided for locking the legs in the bosses, and with this arrangement the motor platform can be adjusted vertically, to tension the V-belt whereby drive is transmitted to the worm shaft.

A 3-in. diameter, 12-tooth, high-speed steel cutter is employed, and the transverse movement of the cross-slide is used to feed it to the required depth. After one flat has been machined, the cross-slide movement is reversed, to retract the cutter from the work, and the turret is withdrawn slightly to the right, to disengage the end of the bar *N* from the collet ring. Next, the spindle is turned through 180 deg., by hand, the turret slide is advanced to re-engage the bar *N* with the second locating hole, and the milling operation is repeated. The flats machined on these spindles engage the slots in the end covers of the Kopp unit which are plunge-milled at the set-up shown in Fig. 2.

Another Ward 2C lathe is equipped with an end-milling attachment, for operations on the ends of small shaft components, which is shown in the close-up view Fig. 5. The workpiece is an indicator shaft, and two deep flats are required to be machined at one end, to provide a driving tongue. At this set-up, the tongue is milled first, with the aid of the special attachment indicated at *U*. This unit comprises a housing in which the

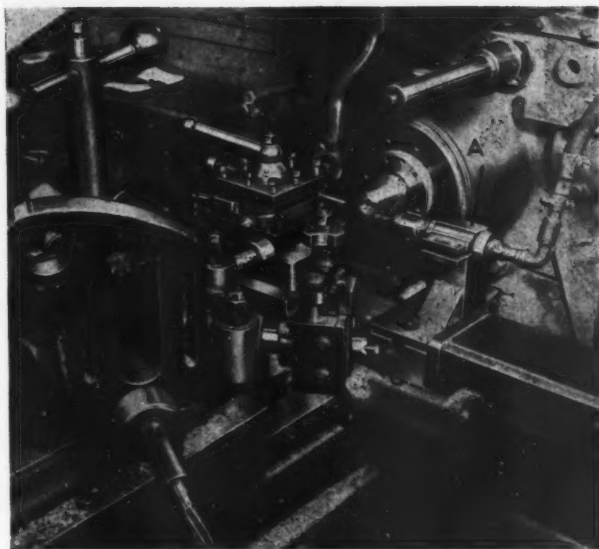
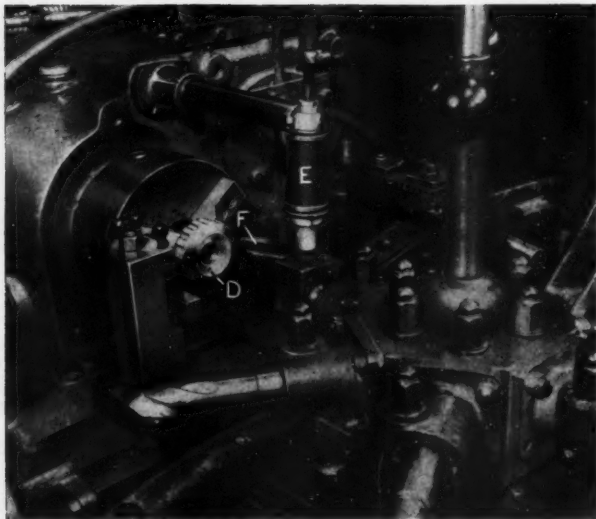


Fig. 6. Transverse drilling and tapping are carried out on this Ward machine in addition to conventional turning and boring operations

milling spindle is mounted on INA needle-type combined journal and thrust bearings (INA Needle Bearings, Ltd., 34/35 Fitzroy Square, London, W.1). The housing is secured to the cross-slide, in place of the rear tool-post, and to one side is attached a Desoutter Mighty-Atom pneumatic drill. Air is fed from the shop supply to the rear end of the drill and the chuck is used to grip a simple self-aligning coupling. This coupling transmits drive to a small pinion, within the casing *V*, which is in mesh with a gear mounted directly on the end of the milling spindle.

With this arrangement, the required reduction in rotary speed is obtained, and the large gear serves as a fly-wheel. The end of the milling spindle is designed to receive a 3-flute collet-type end mill, and the rear tool-slide is first fed towards the operator to sink the cutter to the required depth. Subsequently, the saddle is fed towards the headstock to mill the flat to the required length. The lathe spindle is held stationary during the milling operation by means of a plunger, which engages with an index plate secured to the rear end. To mill the other flat, the spindle is turned through 180 deg. and the plunger is engaged with another slot. When both flats have been machined, the collet is opened and the bar stock is advanced to a dead stop attached to one turret



**Fig. 7.** An air-driven unit on the turret is used to drill an off-centre hole, and taper-turning is carried out from the rear by means of a special attachment

face. The plunger is withdrawn from the index plate, and conventional turning and parting-off operations are carried out.

#### **TRANSVERSE DRILLING AND TAPPING ON A CAPSTAN LATHE**

An air-operated unit is also used for transverse drilling operations on a capstan lathe, and a close-up view of the set-up for machining a brass component on a Ward 2C is shown in Fig. 6. The pneumatic drill is indicated at A, and is carried in a bracket secured to the rear tool-slide. The workpiece here shown is a bearing bush for a small steel worm, which is employed in some types of Kopp units for adjusting the angular position of the iris plate. The latter has a number of teeth cut on a portion of the periphery, and these teeth mesh with the steel worm.

Axial location is ensured by a ring of small-diameter steel balls, which engage with a groove provided in a plain portion of the worm, also with a similar groove in the bore of the bush seen in Fig. 6. This arrangement also serves to take the end thrust of the worm in operation. The small balls are loaded into the groove by way of a transverse hole in the bush, which breaks out into the internal groove. After the balls have been loaded, the hole is closed off by a brass grub screw, which

is retained in position by a wire circlip. The circlip is housed in another groove, in the periphery of the bush, and engages with the screwdriver slot in the screw.

At this set-up, the procedure is as follows. After preliminary turning and boring operations on the bush, the spindle is locked and the unit A is fed in to drill the transverse hole to a tapping size. Next, the spindle is indexed through 180 deg., and the hole is tapped. The tap is carried in a small housing clamped in the front tool box, and is rotated by a handle attached to the shank end, as indicated at B. Subsequently, the front box is indexed to bring a grooving tool to the working position, and the circlip groove is turned in the periphery of the workpiece. This groove intersects the tapped hole, and when it has been completed a brass grub screw is inserted in the hole and screwed down until the head is flush. Next, the wire circlip is assembled to the workpiece, to secure the screw in position.

The length of the grub screw is such that its inner end is flush with the bore of the bush, and the tool C, on the turret, is now applied to machine the ball seating groove in the bore, the groove passing through the plain end of the grub screw. With this arrangement, the ball groove is machined accurately in relationship to the screw-driver slot. As mentioned earlier, the screw is removed to load the balls, and when it is subsequently replaced it is necessary only to engage the circlip to ensure that the groove in the inner end is aligned with that in the bore of the bush. It will be noted that the grooving tool C is carried on a slide which is arranged for vertical movement, so that it can be introduced concentrically with the bore of the work and then moved radially to machine the groove to the required depth.

#### **OFF-CENTRE DRILLING AND TAPER-TURNING ON A CAPSTAN LATHE**

Some Kopp Variators are fitted with a 4-digit numerical-type indicator, which is used to record particular settings of the iris plate. The indicator is located between the speed control knob and the worm for adjusting the iris plate, and with this arrangement a previous setting, giving a known speed of the output shaft, can rapidly be duplicated by turning the control knob until the required

numerical combination is shown. The control knob is of light-alloy extruded bar, and as bought-in it has a number of arcuate grooves in the periphery.

Operations performed on this part include the drilling of a small hole, off-set from the main bore, and machining a wide chamfer at one end. These operations, among others, are performed on a Ward 2C capstan lathe at the set-up shown in Fig. 7, where a workpiece is in position in the chuck.

The chamfered portion on the outer end can be clearly seen, as can the grooves in the periphery, and the off-centre drilled hole is indicated at *D*. The hole *D*, which is at the bottom of a counter-bored portion, is machined by the Desoutter Mighty-Atom air drill *E*, mounted vertically on an adapter secured to one face of the turret. This adapter provides a right-angle drive from the air unit, and the drill projects horizontally from the front face, as can be clearly seen in Fig. 8, which is

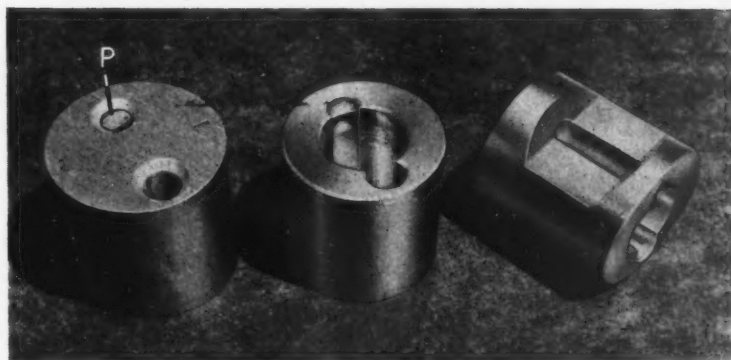


Fig. 9. Three stages in the production of a counter housing incorporating an integral Perspex window

a close-up view of the tools from the operator's position.

The wide chamfer on the workpiece is machined from the rear slide, by means of the tool indicated at *F*, Fig. 7, and with the aid of a special attachment which is mounted in place of the normal rear tool-box. Part of this attachment is visible in Fig. 7, but it can be seen more clearly in Fig. 8. There is a swivel-mounted member *G*, which is adjusted to the required angle in relation to the centre line

of the machine, and secured to the right-hand side of this member there is a cantilever bracket, part of which is indicated at *H*. This bracket serves to support a plate, which carries two vertically-mounted sprockets, embraced by a length of roller chain. The right-hand sprocket, *J* in Fig. 8, is free-running on a stub shaft, but the left-hand sprocket, *K* is keyed to a vertical shaft which extends downwards, through a long slot in the tool-slide.

Another sprocket is keyed to the lower end of the vertical shaft, and engages with a short length of roller chain which is stretched taut and is attached to the under-side of the tool-slide *L*. Supported from one face of the turret, there is a block *M*, with a horizontal bore wherein the rod *N* is clamped. At the left-hand end of this rod there is a sprocket which is secured by a screw passing through its centre, and is prevented from rotating by a second screw, between two adjacent teeth. This sprocket is in

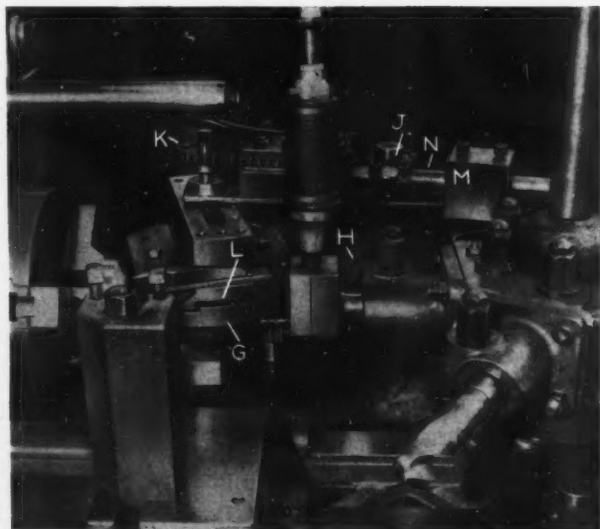


Fig. 8. Close-up view of the special taper-turning attachment seen in Fig. 7

engagement with the outside of the chain which embraces the sprockets *K* and *J*.

It will be appreciated that when power feed is applied to the turret slide, towards the headstock, the sprocket on the rod *N* pushes the chain in a clock-wise direction, as viewed from above, and thus imparts a clock-wise rotation to the sprocket *K*. The sprocket at the lower end of the vertical shaft therefore turns in engagement with the taut chain, and the slide *L* is thus moved towards the operator. Since the slide *L* is set at the required angle, the tool will machine a chamfer on the end of the work.

#### OPERATIONS ON THE NUMERICAL INDICATOR HOUSING

The counter wheels for the numerical indicator mentioned above are supplied by English Numbering Machines, Ltd., Enfield, and are assembled in the bore of a light-alloy housing which incorporates a Perspex window.

A simple but effective method is used for inserting and retaining this window, and three selected

stages from the production sequence for a housing are shown in Fig. 9. The housing is made from bar stock, and at the left can be seen a portion which has been cut off to the required length. Two holes, of different diameters, are drilled in the blank, and in the small hole, at *P*, is pressed a Perspex plug. Cut from rod stock, this plug extends for the full depth of the hole.

At subsequent operations, the housing is faced at both ends, and bored centrally, to bring it to the condition seen at the centre of the figure. It will be noted that the central bore intersects the two previously drilled holes, and that a portion of the Perspex plug is consequently machined away to an arcuate shape. More than 180 deg. of the hole *P* remains, however, so that the Perspex plug is still securely retained. At a final operation, a deep flat is machined in the periphery of the housing, as may be seen at the right. This operation has the effect of producing a sunken rectangular window, and the Perspex is greatly reduced in thickness, with the result that the digits of the counter unit are easily visible.

## Numerically Controlled Drilling and Tapping Machine

With the horizontal drilling and tapping machine shown in Fig. 1, which is built by the Barnes Drill Co., Rockford, Ill., U.S.A., it is possible to programme four motions. This 2-spindle machine will perform operations on cylindrical workpieces with

diameters up to 36 in. and heights up to 72 in. In addition, it will handle parts of conical, and ogival and certain other curved forms.

The head, which is counterbalanced, has vertical movement on the column, and the latter can be traversed through a maximum distance of 24 in. towards and away from the 40 in. diameter table.

Combination drilling and counter-sinking or drilling and counter-boring operations can be performed, also plain drilling, reaming, counter-boring, countersinking, and tapping. Holes can be spaced equally or unequally within  $\pm 0.003$  in. for true position, and setting can be repeated within  $\pm 0.0005$  in.

The table, which is powered by a  $\frac{3}{4}$ -h.p. motor, can be indexed through 360 deg. at a speed of 1.25 r.p.m. A lifting arrangement comes into operation when the table is to be turned and it is automatically clamped when the desired setting has been obtained.

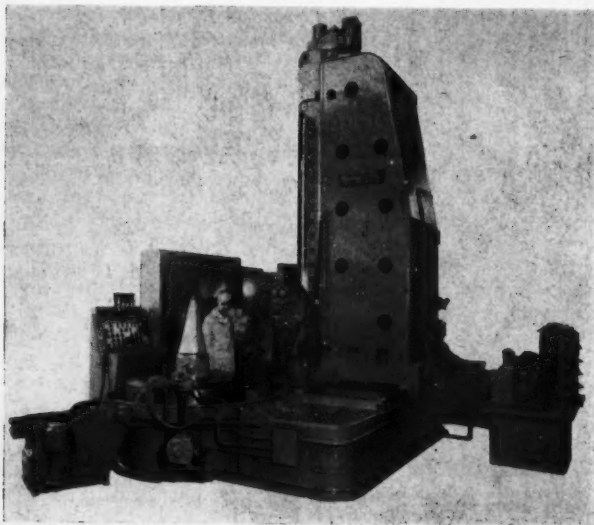


Fig. 1. Barnes drill numerically-controlled drilling and tapping machine for operations on cylindrical and conical parts



**Fig. 2. A close-up view of the machine in Fig. 1 showing the 2-spindle head, the main control panel, and the rack for the pre-set tools**



All the rotary positioning is related to a common reference point to avoid accumulation of error, and the same applies to the vertical settings of the spindle head and the horizontal settings of the column.

Positioning is controlled from information punched in standard 8-channel Flex-O-Writer tape, which is coded in decimal form.

Apart from setting, the system provided for automatic control of the various machine functions and gives instructions to the operator. For example, lights on the control panel indicate when tool changes are required to enable different operations to be performed, and the machine will not function unless the specified tool is in the spindle and all other tools are correctly located in the 6-position rack seen at the left in Fig. 2. For depth control,

there is a special device which senses the distance that the tool has penetrated from the work face.

When all holes in one row have been completed, the spindle head is automatically re-positioned vertically, and, if necessary, the column is moved in or out.

The Barnes Drill Co. are represented here by Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, Battersea, S.W.11.

## Newage Portable Hardness Tester

Metallurgical Services, Reliant Works, Betchworth, Surrey, are now distributors, in this country, for the Newage portable hardness tester, here



illustrated, which is made in the U.S.A., and is covered by patents. This instrument incorporates a pre-loaded diamond indenter and to make a test it is only necessary to press the hand grips towards the specimen. Movement of the indenter, as penetration takes place, compresses a diaphragm whereby fluid is forced hydraulically into a capillary tube, and the final position of the fluid indicates the hardness value directly on a scale.

The housing is of brass, with a chromium plated finish, and the nose piece, of hardened steel. Each instrument is hand calibrated with reference to master test blocks, and the dials are individually graduated to ensure accuracy throughout the range. It is stated that readings accurate to 1.5 points Rockwell can be obtained. Instruments are available with ranges corresponding to Rockwell A, B or C, also Brinell ranges of 50 to 260, or 100 to 440.

**Newage portable hardness tester which is available for either the Rockwell or Brinell systems**



# The Production of Printed Circuits and Industrial Nameplates

Methods Employed by Millett, Levens (Engravers), Ltd., and Printed Circuits, Ltd.

By S. C. POULSEN, Associate Editor

IN AN EARLIER ARTICLE IN MACHINERY, 99/592—13/9/61, attention was drawn to some of the methods employed by Millett, Levens (Engravers), Ltd., Stirling Corner, Barnet By-pass, Boreham Wood, Herts., and their subsidiary company, Printed Circuits, Ltd., for producing printed circuits and industrial nameplates. The various processes discussed—which are basically similar for both types of product—included photographic reduction of the oversize master drawing; subsequent duplication of the resulting actual-size master negative, on a “step-and-repeat” camera, to produce multiple-image works negatives; emulsion-coating and contact-printing of circuit-boards and work sheets, also zinc plates for offset litho printing; offset printing of etch-resistant media on to circuit-boards and metal sheets, from the zinc

plates; and coating the printed media with bitumen powder, followed by baking, to increase etch-resistance. Reference was also made to the methods used for producing strain-gauges, and other small accurate items, by foil-etching techniques, and to the plant employed for automatic etching and anodizing operations.

## AUTOMATIC PROCESSING PLANT

A general view of a recently-installed rotary-transfer automatic etching plant is given in Fig. 1. This plant, which was built to the firm's specification, can be used for etching copper (including circuit-boards) brass, stainless steel, and aluminium, and provided that the processing times are suitably balanced, any three of these materials can be

handled simultaneously. A total of 15 radially-disposed carrier-arms is provided, each of which will accommodate three plastics-covered jigs, suitable for sheets or boards up to 18 in. by 24 in., and these arms are raised, indexed, and lowered, to transfer the work from tank to tank.

The No. 1 main tank, seen in the foreground, contains ferric chloride solution of 35 deg. Beaumé density, which is suitable for copper, brass and stainless steel. This tank is totally enclosed, except for three narrow open channels in the top, which provide the necessary clearance for the shanks of the jigs, and it is provided with 16 impellers that deliver a spray of

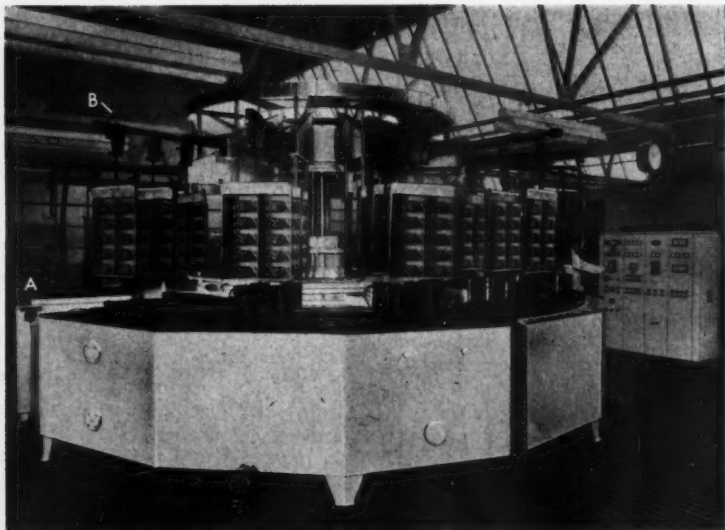


Fig. 1. General view of the recently-installed automatic rotary-transfer plant for etching copper (including printed circuits), brass, stainless steel, and aluminium

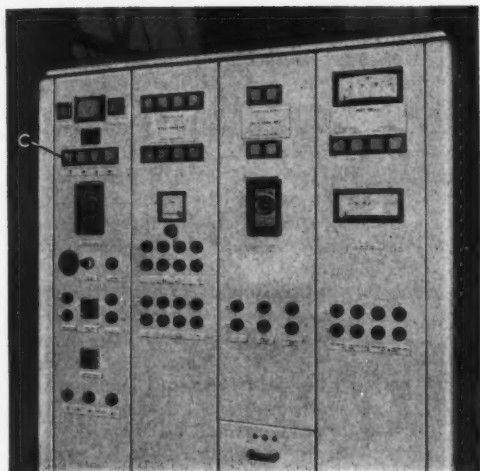


Fig. 2. View of the main control-panel of the automatic etching plant, showing the principal features. The controls for No. 1 and No. 2 tanks are grouped at the left and right

etchant on to the work. The design of the No. 2 main tank, for etching aluminium, is generally similar, and it contains a dilute solution of spent ferric chloride from No. 1 main tank.

Unloading and reloading of the carrier-arms is carried out at station A, Fig. 1, and the appropriate processing sequence for the work loaded on each particular carrier-arm is pre-selected by means of a small lever on the outer end. One of these levers is seen at B. If the work is to be processed in No. 1 tank, the lever is moved towards the operator, and for No. 2 tank, in the opposite direction. Assuming that the first of these two positions has been selected, the processing sequence is as follows. The work is raised, indexed, and lowered into No. 1 main tank, along which it is then traversed by successive indexing motions. On reaching the end of the etching tank, it is transferred to a cold water spray tank for rinsing.

After the work has been rinsed, it is kept raised during several of the ensuing indexing motions, so that it "skips" the No. 2 main tank, after which, if it is in the form of metal sheets, it is lowered into a chromic acid dip, to remove smut. Circuit-boards, however, are lowered into another solution, at the same station, to strip the etch-resist. At this and similar stations, the different solutions are contained in removable plastics liners, which are placed in the main tanks, and the solution to be used is pre-selected, at the loading station, by

locating the work at the appropriate radial position on the carrier-arms.

Following this stage, the work is again spray rinsed, and after the next indexing motion, metal sheets are lowered into a nitric acid dip, contained in another of the plastics liners, whereas for circuit-boards, the station is idle. Next, all work is rinsed in hot water, and is then transferred to a hot-air drying section. Here, the hot air is forced upwards through perforations in the floor of the "tank," and extracted at the rear, near the top. Finally, the dried work is indexed to the unloading station, where the sheets and boards are removed from the carrier-arms at the rate of three every 4 to 5 min., according to the thickness of the copper on the circuit-boards. The processing sequence for aluminium is somewhat simpler. Immediately after the work has been loaded, the carrier-arms are raised, and remain in this position to skip the No. 1 main tank. Etching in No. 2 tank is followed by an idle station, cold rinsing, nitric-acid dipping, hot rinsing, and hot-air drying.

#### CONTROLS

All controls are centralized on the main electrical cabinet, as shown in Fig. 2, and are grouped to left and right, to correspond, respectively, to the No. 1 and No. 2 series of tanks. The first panel, at the extreme left, incorporates signal-lamps that indicate the various main functions, including a series at C, which show, by means of associated arrow marks, the separate motions of the indexing and transfer mechanism. Below this set of lamps, there is an adjustable process timer, whereby the dwells between the transfer motions can be pre-set to any duration from a few seconds to a maximum of 6 hours. Other controls on this panel are concerned with oscillating motion for tank agitation, emergency stopping, and the selection of "hand" or "auto" operation. In addition, there are various manual controls for use with the "hand" setting. The second panel for the No. 1 processing sequence incorporates signal-lights and controls associated with the spray impellers, and a meter that affords continuous indication of the Beaumé value of the solution in any selected tank.

One panel of the right-hand group gives similar facilities for the impellers of No. 2 main tank, but instead of a Beaumé meter, there is another adjustable process timer, for controlling an auxiliary hydraulic ram. In conjunction with the timer, this ram can be used to raise the work from the No. 2 main etching tank, after a controlled period of immersion, independently of the main transfer mechanism. The immersion period

may thus be shortened, without affecting the processing times at the other stations. Temperature gauges, and adjustable thermostatic controls, for adjusting the temperatures of the hot rinsing and hot-air drying tanks, are mounted on the panel at the extreme right, which is also provided with controls for the electric heaters, and the hot-air fan motors. The entire plant can be run by one operator, who, between loading and unloading the carrier-arms, periodically checks the various functions at the control-panels.

#### AUTOMATIC DYE-ANODIZING PLANT

A second, generally-similar, plant has been installed by the company, for the automatic anodizing and dyeing of aluminium nameplates and panels. This equipment incorporates a total of 40 carrier-arms, and the processing sequence is as follows. (1) Hot alkaline clean; (2) cold water wash; (3) brightening dip; (4) cold wash; (5) main anodize. During the latter stage, for which a sulphuric acid solution is employed, current is conveyed to the work through the carrier-arms and jigs. For this purpose, the plastics-covered jigs are provided with small clamp-type electrical contacts, that lightly grip the sheets near the edges. The temperature of the bath is thermostatically controlled, and should it exceed a certain value, submerged water-cooling coils are brought into operation automatically.

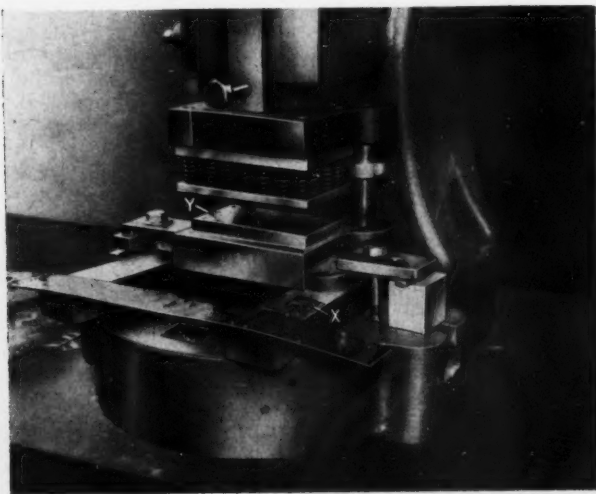


Fig. 3. Typical fly-press tool, for piercing and blanking two small circuits at a time, from the guillotined strip. The output is 1,102 pieces an hour

The various stages that follow the main anodizing process (5) comprise (6) cold water wash; (7) hot air dry; and (8) unload and reload. At stage (8) it may be noted, the anodized sheet is unloaded for transfer to the offset litho printing department, where the pattern of dye resist is applied by the methods already described. Printed sheets, returned from the litho department, are reloaded on to the carriers at station (8), and subsequent immersion in any one of three dye-tanks, during stage (9), is selected by positioning the work radially on the carrier-arm, and by means of an associated push-button. One of the dyes, necessitating a longer period of immersion, is contained in a tank situated towards the rear at section (9), whereas the other two, requiring shorter periods, are at the front. Depression of the button, or omission to do so, selects the front tank into which the work will be lowered.

Immersion in the required dye is followed by (10) cold water wash; (11) strip resist; (12) cold water rinse; (13) seal anodic surface and dye in nickel acetate sealant; (14) hot-air dry; and (15) unload. The mechanical arrangements for skipping certain tanks—for example, for the automatic selection of the dye colour sequence, or the omission of the sealing stage (13) to permit the subsequent addition of other colours—are generally similar to those for the etching plant. In the anodizing tank, both the voltage and the amperage are controlled automatically, and associated equipment

on the main panel includes a voltmeter, an ammeter, and a temperature gauge. Corresponding instruments for each of the three dye tanks, all of which are heated and thermostatically controlled, comprise a pH meter and a temperature gauge. As on the control-panel of the etching plant, all the functions in operation at any given time are indicated by signal-lights. The anodizing plant, it may be noted, is readily adaptable for plating operations.

For each plant, all fume-extraction is effected downwardly, through ducts and a ring manifold situated within the circular area enclosed by the tanks. From the manifold, another duct passes beneath the wooden floor-grilles, to an extractor unit mounted on the wall of the shop. The ducting and manifolds are of plastics material throughout, to eliminate corrosion. Safety devices provided for each plant include a set of three prominent signal-lights, similar to traffic-lights.

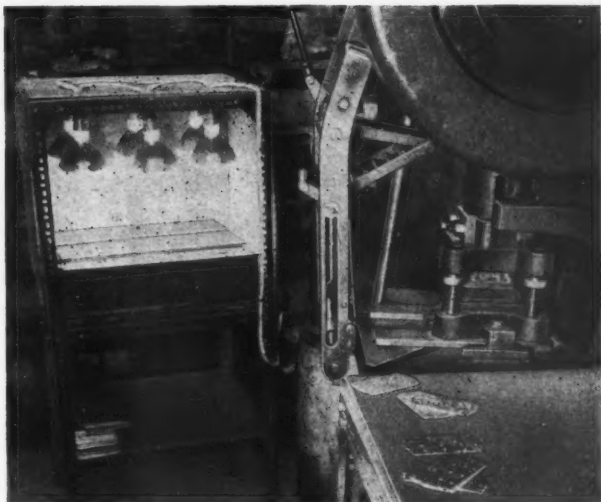
Green denotes "safe to load"; amber, "caution—machine about to operate"; and red, "keep clear, machine in operation."

#### "TOOLING" SECTION

As indicated in the preceding article, the various processes employed for the bulk of the circuits and nameplates are such that several of these items are produced simultaneously on each "standard" 24-in. by 18-in. or 20-in. by 18-in. board or sheet. In addition, facilities are available for the production of individual or multiple circuits and panels on boards and sheets of areas up to 25 sq. ft. The subsequent operations of cutting the processed boards and sheets into separate units, and drilling, piercing and blanking the units, as required, are performed in a department known as the "tooling" section. This section, which is provided with tool-making facilities, is also responsible for the forming of various sheet-metal items, machine engraving, and dividing. Equipment available includes guillotines, fly-presses, power presses of various capacities up to 80 tons, and a variety of drilling, milling, and other general-purpose machines.

The procedure followed after processing, by the methods that have been described, differs slightly according to the nature of the product. Whereas the etched circuits and anodized nameplates are transferred directly to the tooling section, etched nameplates are first spray painted, before the resist has been removed, to provide the required background colour in the etched impressions. Next, the work is partly stoved, and the resist is removed by a process termed "padding-off", which entails swabbing with a selective solvent that does not affect the paint. The work is then spray lacquered and fully stoved. Large panels, which will be subjected to extensive work and handling, are spray coated with Birlon strippable protective film.

The methods employed in the tooling section also differ somewhat, according to the product, and are determined by such factors as size, quantity, economic justification for making press-tools, and—in the case of printed circuits—the types of base-materials. These materials, it may be noted, differ widely in thickness, and in suitability, or otherwise, for such operations as piercing and blanking. Typically, the metal sheets are guillo-



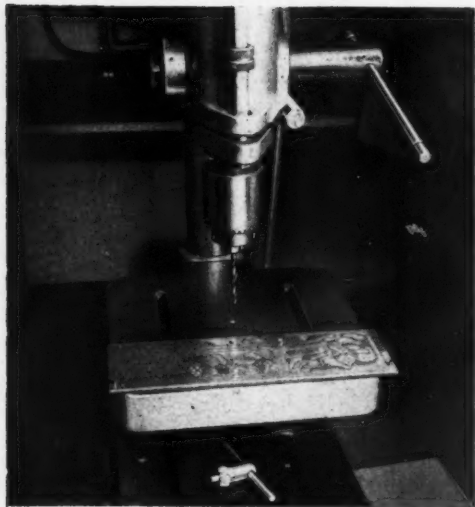
**Fig. 4.** The heating of certain printed circuits, for piercing and blanking, is facilitated by the use of infra-red lamps, as seen at this power-press station

tinued into strips, from which the individual nameplates are then blanked and pierced on fly-presses. As far as is practical, this procedure is also followed for printed circuits, but where the quantities are insufficient to warrant making press-tools, or the thickness or other characteristics of the base material render it unsuitable for guillotining and piercing, it is sawn and drilled. For work in this category, slots and shaped apertures, that would normally be produced by piercing and blanking, are routed on pantograph engraving machines.

#### PIERCING AND BLANKING

Much of the work on circuit-boards is concerned with the production of large numbers of small holes, and a typical 2-stage fly-press tool, for piercing and blanking small circuits, two at a time, is shown in Fig. 3, a pair of the pierced and blanked components being indicated at X. As may be observed, the punch assembly incorporates a stripper-plate backed by a large number of compression springs, and a total of six guide-pillars is provided, each of which is surrounded by one of the springs. This arrangement ensures that the slender punches are adequately guided and steadied, and that the work is tightly gripped. Firm clamping is particularly necessary, to minimize de-lamination and similar damage to the





**Fig. 5.** Typical drilling template, inverted to show the etched replica, produced by printed-circuit technique, which eliminates the necessity for marking-out

base-material, in the vicinity of the holes and blanked edges. The guillotined strip, with tooling holes previously drilled or pierced, is located on the lower tool by means of the pins Y. At the first station, 25 holes of  $\frac{1}{32}$ -in. diameter, and two of 0.05-in. diameter, are pierced in each circuit. At the second, the components are blanked from the strip, which is  $\frac{1}{32}$  in. thick. The output is 1,102 pieces an hour.

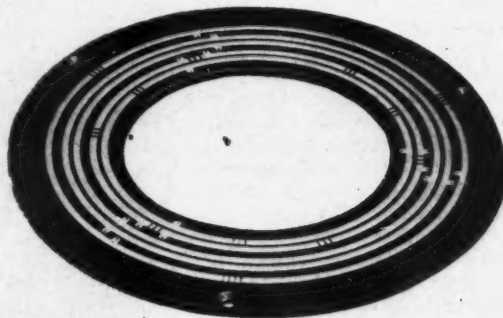
Work which cannot conveniently be handled on the fly-presses is pierced and blanked in the power-press section. For certain types of base material, heating is necessary, and a station in the power-press section, arranged for such an operation, on a 30-ton press, is shown in Fig. 4. Next to the operator's position is installed a cabinet incorporating a group of six A.E.I., 250-watt, bell-type, infra-red lamps. Typically, boards are placed beneath the lamps in stacks of about 12 at a time, and are left for 5 to 10 min., to become partly heated. Thereafter, the working interval between the removal of the uppermost board and the next, provides the necessary period for each board, in turn, to

reach the required temperature. The example illustrated is a circuit on glass-fibre reinforced base-material, and in this instance, piercing is carried out cold. At the hot blanking set-up, the output is 250 pieces an hour.

Where the quantities involved do not justify the preparation of press-tools, or the material is unsuitable, the circuits are drilled from steel templates, on small single-spindle bench drills. Because of the wide range of hole sizes, and the varying, unsymmetrical positioning of the holes, it may be noted, the use of multiple-spindle heads is impractical. The slow-spiral high speed steel drills employed are ground to a fairly acute point-angle, with little or no back-clearance, so that the tendency to chip or shatter the work on break-through is minimized, and for the smallest size (No. 72) a speed of 4,260 r.p.m. is used.

#### TEMPLATE PREPARATION

In the preparation of the templates, one of which is shown in Fig. 5, the necessity for marking-out is eliminated by the use of printed-circuit technique. For this purpose, the steel plate is emulsion-coated, contact-printed and etched, in the same way as the circuit-boards, so that a replica of the circuit is reproduced on the surface. This replica then serves as a guide, for centre-punching and drilling, and since it is prepared from the same negative, no extra work is entailed, and exact register of the holes with the copper circuit is ensured. Such templates are usually arranged so that the etched face is in contact with the work, and errors due to drill "wandering," at the template-drilling stage, are thereby minimized. On the upper face, the holes



**Fig. 6.** Important economies in the production of major items, such as this electrical contact slip-ring, can be effected by the use of printed-circuit methods





**Fig. 7.** The visual inspection of printed circuits on translucent base-materials is facilitated by the use of light-boxes, of the simple design here shown

are marked in accordance with a colour coding system, as an aid to drill-size identification. A similar etched replica technique is used to facilitate the preparation of piercing and blanking tools.

When the various operations described have been completed, any circuits requiring component identification marks are returned to the printing section. Here, the marks are printed on the backs of the boards, either by the offset litho or silk-screen process, the pierced or drilled holes, meanwhile, being used to locate the work. As a precaution against damage to the marks during subsequent handling, the backs of the boards are sprayed with a protective lacquer. Thereafter, the procedure is substantially the same as for unmarked work. The copper face is polished by buffing, and if required, is gold, rhodium, palladium, or otherwise flash plated. Finally, it is sprayed with a flux lacquer, both as a protection against corrosion, and to facilitate subsequent soldering, and the work is then passed to the inspection department.

It may be noted that the various flash coating materials indicated are being used increasingly for printed-circuit switches and contacts. Rhodium, for example, does not tarnish, and when used with gold- or palladium-alloy brushes, affords several advantages, which include low electrical contact-resistance, and long working life. Integral com-

ponents of these materials are readily incorporated in printed copper circuits, with corresponding savings in space, and in production and assembly costs. Similarly, individual components, which normally require machining and other work, can frequently be produced more economically, by the use of printed-circuit methods. An example is the large electrical contact slip-ring, for a printing machine, shown in Fig. 6. This item comprises an insulating base of  $\frac{1}{8}$ -in. plastics material, of approximately 15 in. diameter, with a series of rhodium-plated copper conductor bands. For multiple-contact switching applications, the metal portions can be made flush with the surface of the base material, to minimize friction and wear, by means of a "flush bonding" technique entailing the use of epoxy resin.

### INSPECTION

In the inspection department, all checking is carried out visually, by women, and where the circuits are on translucent base-material, this work is facilitated by the use of light-boxes, as shown in Fig. 7. Typical defects for which the work is examined include discontinuities in, and "bridging" between, the copper lines. The commonest causes of discontinuities are foreign matter, dust, or other flaws in the resist, which result in under-



**Fig. 8.** Where the quantities justify the preparation of such equipment, small electrical testing jigs are used for checking certain types of printed circuits

cutting at the etching stage. Bridging is usually the result of the flowing-together of certain portions of the resist, either during printing, or subsequent bitumen coating and baking. For certain types of circuits, and where the quantities justify the preparation of such equipment, the work is checked on low-voltage electrical test jigs of the design shown in Fig. 8.

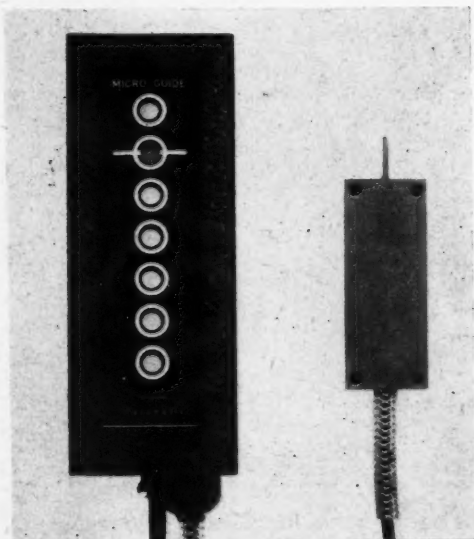
The work is located, copper face downwards, in engagement with contacts that protrude from an insulating surface, as seen at Z, and "shorts" and discontinuities are indicated by the illumination, or

failure to illuminate, of the associated signal-lamps. Jigs of this design are readily prepared by fitting one of the circuit-boards with the necessary contacts, the latter being provided by inserting small screws through the holes in the board, and securing them with nuts on the copper face. Alternatively, the screws may be soldered to the copper. The particular circuit seen in Fig. 8, it may be noted, affords an example of integral printed-circuit components. It comprises a television "triplexer" for Wolsey Electronics, Ltd., and incorporates four high-frequency inductors.

## Paramatic Micro-Guide Workpiece Sizing Equipment

The Micro-Guide equipment shown in the illustration, has recently been introduced by Paramatic Developments, Ltd., Canal Street, Derby, to provide a convenient means of controlling workpiece size during the final stages of machining. It is stated that it may be used to particular advantage on worn machine tools.

A single, sealed, measuring head as shown on the right-hand side of the figure, or, alternatively, two heads, may be connected to the indicator unit, which is intended for operation from a single-phase power supply, and is normally mounted in a convenient position for viewing by the operator.



Paramatic Micro-Guide workpiece sizing equipment which may be used on worn machine tools

Coloured lamps, arranged vertically on the indicator unit, are lit in turn by deflection of the stylus arm on the measuring head sideways in either direction, through built-in contacts. Holes are provided in the 4-in. long body to take screws for fixing the measuring head to a machine.

The lowest (green) lamp is lit by deflection of the stylus arm when the workpiece has been brought to within 0.025 in. of the required size, for instance, after a rough machining operation, and, at the same time, a buzzer sounds.

This lamp remains illuminated while machining proceeds, and when the work has been brought to within 0.005 in. of the desired size, it is extinguished, and the next (amber) lamp is lit. Other amber lamps are illuminated, in turn, as the workpiece size is reduced by steps of 0.001 in., and when the required dimension has been obtained, a red lamp is lit. In the event of the workpiece being accidentally machined under-size by 0.001 in., the topmost (blue) lamp is lit, and a warning bell rings. If required, provision can be made for the lamps to be lit as the workpiece size is reduced in increments of less than 0.001 in.

When the equipment is employed on a turret lathe, for example, the length stops for the turret slide may be adjusted individually, so that they deflect the stylus arm on the measuring head to illuminate the red lamp at the end of each cutting stroke. A second measuring head may be connected to the same indicating unit, and operated by other stops during the final part of the cutting stroke of the cross slide in either direction. The equipment may also be used for sorting workpieces for size, monitoring automatic machining operations, checking the positions of components in jigs and fixtures for accuracy, and on centre lathes which are set up for machining batches of work. An adjustable contact arm is available for centre lathe applications.

## Boeing Plasma Laboratory

The Aero-Space Division of the Boeing Airplane Co., Seattle, Washington, U.S.A., have recently established a plasma laboratory to develop methods of producing high-velocity jets of pure air at high temperatures, which can be maintained for considerable periods. Recently, it is stated, a 1-MW. arc-type plasma-jet wind tunnel was operated continuously for 33 min. with uncontaminated air. Such facilities, it is pointed out, will be of great value in connection with the testing of nose cones, leading edges and other surfaces of missiles and space vehicles under re-entry conditions.

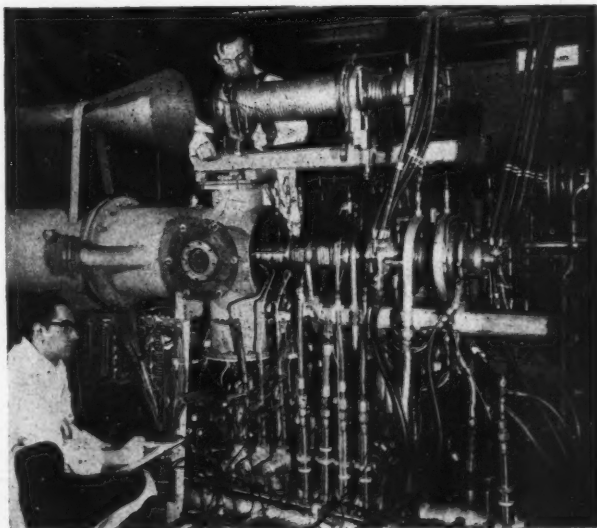
For early plasma jets, electric arcs between carbon electrodes were employed, but the carbon burned away rapidly and impurities were introduced into the jet stream. This difficulty has been overcome by the adoption of copper tube electrodes with water cooling, which have long life and do not pollute the jet. These copper tube electrodes may take the form of opposed rings of equal diameter, or concentric rings. Electrodes of oblong shape can also be used where broad, thin jets are required for testing wide models such as wing leading edge sections.

The electrodes are located at a distance of 1 to 2

in. apart, and are connected by several pieces of fine wire. When starting up, a 2,200-lb. per sq. in. air supply is first connected to a pipe leading to the electrodes, and cooling water, at a pressure of 600 lb. per sq. in., is circulated at the rate of 240 gal. per min. through the electrode tubes and into a separate system of copper coils enclosing other equipment which must be cooled. Next, a 4,000 amp. d.c. supply is switched on to energize the electrodes, and the wires between them vaporize in a flash explosion, which forms a plasma. This plasma is a conductor of electricity and the arc continues to flow, from a spot on one electrode to a spot on the other.

Owing to the intensity of the heat, the copper becomes liquid at the points of contact of the arc. Rupture of the tubes is prevented by a magnetic field which is induced around the electrodes by current flowing in water-cooled copper coils. The magnetic field causes the points of arc contact to move around the copper tube electrodes at high speed, and molten spots on the tubes harden instantly after the arc has passed.

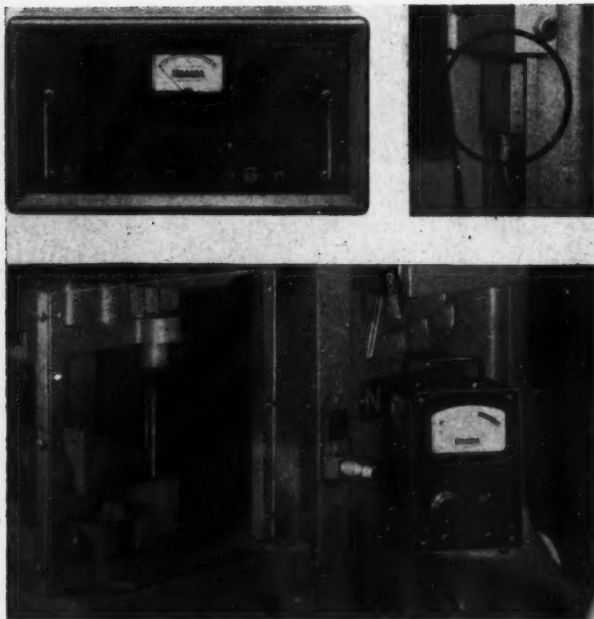
The Mach  $2\frac{1}{2}$  to 3 plasma jet tunnel shown in the accompanying figure, which is now in operation, incorporates vacuum equipment capable of simulating altitudes up to 95,000 ft. Temperatures of the circular plasma jet of this tunnel are estimated to be 20,000 deg. F. at the core, and 12,000 to 15,000 deg. F. at the perimeter. A Mach 5 to 7 plasma jet wind tunnel, with altitude simulation up to 200,000 ft., is under construction.



Mach  $2\frac{1}{2}$  to 3 plasma-jet wind tunnel installed in the laboratory of the Boeing Airplane Co., Aero-Space Division

## Niagara Load-measuring Instruments for Presses

Niagara Machine & Tool Works, Buffalo, N.Y., U.S.A., who are represented in this country by Wickman, Ltd., Fletchamstead Highway, Coventry, have recently introduced two electronic instruments for measuring the loads imposed when presses are in operation. As a result, risk of damage due to overloading can be avoided. The No. 112 "Load Monitor," shown at the upper left in the figure on the next page, serves to indicate continuously the load on a machine—from 0 to 140 per cent of the rated capacity—and it is stated that the speed of response and accuracy are not affected by the working rate. A special tripping circuit is



For indicating continuously the load applied during operation of a press, the Niagara No. 112 Load Monitor (upper left) is connected to pick-up heads on the machine (upper right). The portable No. 119 Tonmeter (lower view), when plug-connected to a pick-up, shows the maximum load during a working cycle

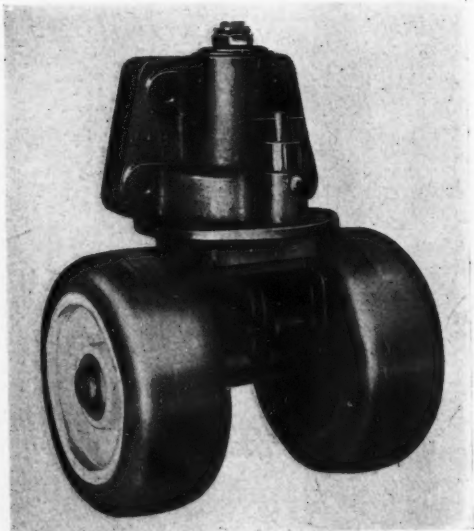
provided, whereby the clutch in the drive system for the press is disengaged when the loading rises to a pre-determined percentage of the capacity, and, if required, arrangements can be made for the simultaneous operation of a warning signal. There is provision for locking the setting controls, to prevent unauthorized adjustment. The unit is connected to two or four pick-up heads, which are attached to the tie bars or frame of the press, as seen at the upper right in the figure, and can be arranged well clear of the die and feeding areas.

The battery-powered, portable, No. 119 Tonmeter, seen in the lower view, is designed to indicate the maximum load on a press during the operating cycle, also for use when setting up. For checking, the trailing lead from the instrument is connected to a socket on a pick-up head mounted on the frame of the machine. A dial provides for setting in accordance with the capacity of the press, and the response is not affected by the working rate.

## New Autoset Swivelling Wheel Unit

Autoset (Production), Ltd., 76-82 Stour Street, Birmingham, 18, have recently added to their range the swivelling wheel unit seen in the figure, which is designed to carry dynamic loads up to 2 tons. The twin, 10-in. diameter, rubber-tyred wheels are mounted on needle roller bearings, which run on a hardened and ground shaft and each wheel has an individually-adjustable, internal expanding, brake, of 6½ in. diameter. These brakes are applied by means of a cantilever arm, which is heavily spring loaded, and are released by the upward movement of a rod that extends axially through the vertical swivel pin. The lower end of the rod is located in a universal ball arrangement on the arm. Taper roller bearings are incorporated in the swivelling head, and the wheel carriage may be locked in four angular positions by means of a spring-loaded plunger.

Towing lugs are provided, and two units can be connected together for steering by the Ackerman system.



Autoset swivelling wheel unit, for carrying dynamic loads up to 2 tons



# 7th European Machine Tool Exhibition-Brussels

## FOURTH ARTICLE

### FRONTOR 40 FRONT-OPERATED SINGLE-SPINDLE CHUCKING AUTOMATIC

The West German firms of J. G. Weisser Soehne and Maschinenfabrik Diedesheim G.m.b.H. (Sykes Machine Tool Co., Ltd., The Hythe, Staines, Middlesex), jointly developed the front-operated automatic chucking machines, which are marketed under the name Frontor, and are available in two sizes. The Frontor 40, shown in Fig. 1, is made by Maschinenfabrik Diedesheim G.m.b.H., and has a maximum turning capacity of  $19\frac{1}{4}$  in. diameter. The smaller, Frontor 25 machine, with a capacity of  $10\frac{1}{2}$  in., is built by J. G. Weisser Soehne, and is of generally similar design.

On the Frontor 40, drive to the headstock is taken by belt, through an electro-magnetic clutch and brake unit, from a motor which may range from 10 to 27 h.p. according to requirements. Spindle speeds from 35 to 1,400 r.p.m. can be provided, and if a small range will suffice, the

speeds are obtained by change gears, and the ratio between the final gear shaft and the spindle is fixed.

To provide a wider speed range, sliding gears are incorporated in the drive. All the gears are of high-tensile steel, heat-treated and ground. The main spindle gear runs in an oil bath, and the remaining gears are splash lubricated.

The spindle is mounted in double tapered roller bearings and a hydraulic chuck, which may be of 9",  $11\frac{1}{2}$ ", or  $15\frac{1}{2}$ " in. diameter, is mounted on the flange, as close as possible to the front bearing. If two spindle speeds are required during the cycle, a pole-changing motor can be fitted. Alternatively, steplessly-variable control, either by a d.c. motor, or a mechanical unit, can be provided, and several spindle speeds can then be obtained during a cycle.

Right- and left-hand tool slide units may be of the same or different types, that most commonly fitted having a transverse travel of  $8\frac{1}{2}$  in., and a longitudinal travel of 9 in. The slide units can be set at different distances, in increments of 4 in., from the chuck face. A choice of slide units is available, that designated type L having hydraulically-actuated longitudinal movement and a screw-operated transverse motion. With the type P unit, this arrangement is reversed. A type LP slide unit has hydraulically-actuated motions in both directions, for working to stops, and with the LK unit, hydraulic copying facilities are available in the longitudinal direction. There is also a type LPK tool slide with provision for hydraulic copying in both directions of travel, and, if desired, a slide arrangement can be supplied which permits longitudinal and transverse copying as well as turning to stops. Feed rates are steplessly-variable from  $\frac{3}{32}$  to  $19\frac{1}{4}$  in. per min.

Control of the feed rate is normally obtained by throttling the flow of oil, but if a constant cutting speed control is provided for facing, variable speed pumps, driven from the work spindle, are employed to maintain a constant feed per revolution. The electric and hydraulic controls for the tool slides are housed in boxes on each side of the bed, and push-buttons for the individual motions are incorporated to facilitate setting up the

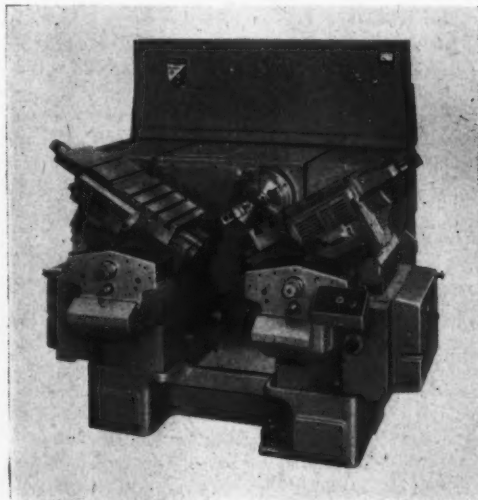


Fig. 1. Frontor 40 single-spindle chucking automatic for turning up to  $19\frac{1}{4}$  in. diameter



machine. A punched card control system can also be applied, and automatic work loading and unloading mechanism is available if required.

#### HATEBUR NUT FORMING AND COLD HEADING MACHINES

Machines built by F. B. Hatebur, Basle, Switzerland (P. A. Mead, Ltd., 3 Vincent Parade, Hanley Road, London, N.4), for cold forming blanks for hexagon nuts in sizes up to 17 mm. (0.7 in.) across flats, also other components, such as screw plugs and rollers for chains, have recently been the subject of some design improvements, and the latest type PKE-10 pre-forming machine, and type PKZ-1 multiple-station press for finish forming, are shown, respectively, in Fig. 2 and Fig. 3. On the first of these machines, slugs of the required volume are cut from cold drawn steel bar, and the hexagon shape is formed, also a chamfer at one end. At the same time, the end faces are formed accurately parallel. Following annealing, and, if required, other processes such as barrel finishing and phosphating, the partly-formed blanks are delivered to the press by way of a hopper feed unit.

At the first working station on the press, the central hole is formed from both ends of the blank for a depth which leaves a thin central web, and a second chamfer may be produced if desired. The blank is now moved to the next station by a transfer mechanism, and the web is then punched out to clear the hole. Another transfer movement brings the blank to the third working station,

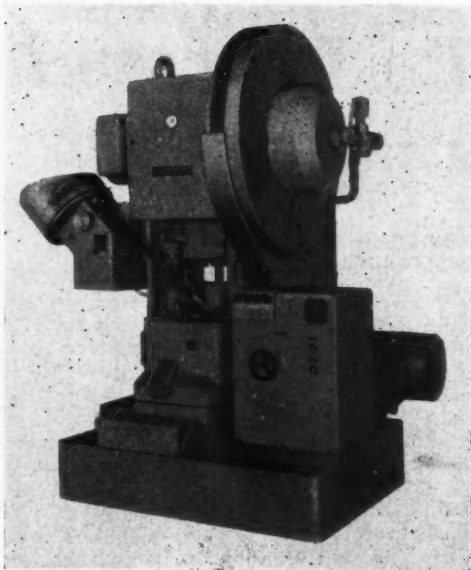


Fig. 3. Following annealing, partly-formed nut blanks are delivered to this Hatebur type PKZ-1 multiple-station press for finish forming

where both ends of the hole are chamfered. The machines have a capacity for producing blanks at the maximum rate of 130 per min.

An entirely new, type BKA 2, automatic progressive cold heading machine will be shown, which has a capacity for producing blanks for bolts and other components from steel bar up to 14 mm. (0.55 in.) diameter. Blanks for  $\frac{3}{8}$ -in. diameter bolts, for example, can be produced on this machine at the rate of 120 per min. A maximum of four cold forming operations may be carried out on the work during the operating cycle, and each piece cut off from the bar is brought to the first die by continued movement of the cutting-off slide. The gripper jaws on the mechanically-operated transfer mechanism can be adjusted independently for opening and closing, and the ejectors can be set separately, to suit the individual stages of the forging operations.

The machine is driven by a variable-speed motor, through an electro-pneumatic clutch and brake unit,

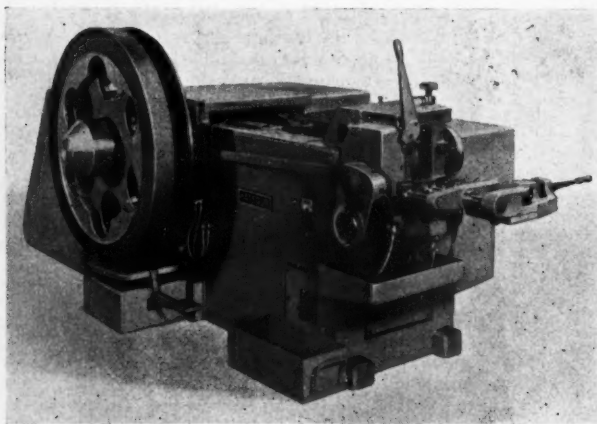


Fig. 2. Hatebur type PKE-10 machine for cold pre-forming operations on blanks for hexagon nuts

which is operated by push-buttons on the control desk. Various safety arrangements are incorporated, which are arranged to operate a micro-switch to de-energize the clutch if a pre-set load is exceeded during forging. A very slow motor speed is provided which enables the tool slides to be "inched" to facilitate setting up.

### **PFAUTER TYPE P. 2300 GEAR HOBBIING MACHINE**

The type P. 2300 gear hobbing machine, shown in Fig. 4, from the range built by Hermann Pfauter, Ludwigsburg, Württ., Germany (Vaughan Associates, Ltd., 4 Queen Street, Curzon Street, London, W.1), is of similar design to the type P. 1800, but of larger capacity. It enables gears up to 92 in. diameter, with a maximum of  $1\frac{1}{2}$  d.p., and numbers of teeth down to 12, to be cut in steel of 38 tons per sq. in. tensile strength. If required, the machine can be supplied for cutting gears with numbers of teeth down to 6. The capacity for face width is 30 in. for spur gears, and  $27\frac{1}{2}$ , 16, and 10 in. for gears of the largest diameter that can be handled on the machine, which have helix angles of 30, 45, and 60 deg. respectively.

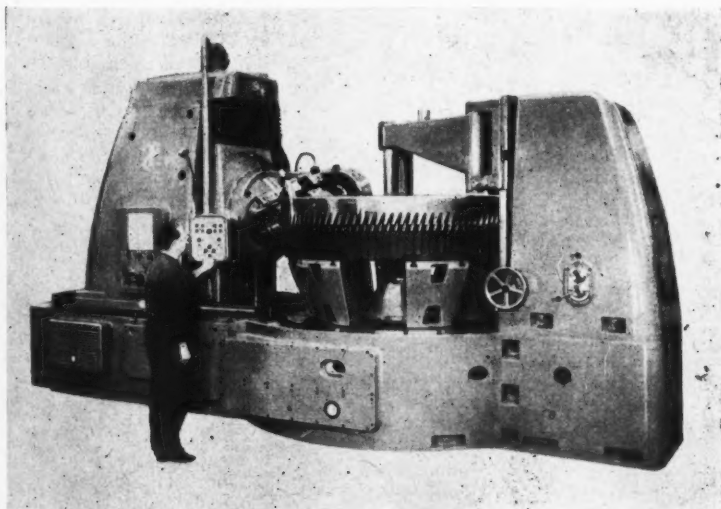
As with other machines in the P range, the column which carries the universal hobbing head is moved towards and away from the cutting position on guideways at the left-hand end of the bed. Setting for depth of cut is made with reference to a micrometer dial mounted on the

control panel built into the column. A tailstock, which can be adjusted vertically, and locked in the required position, is mounted on guideways on a column at the other end of the bed, for supporting the upper ends of mandrels or shafts integral with gears, when fairly small-diameter workpieces are to be handled. The tailstock arm is of split design, and the component parts can be swung outwards clear of the working area by means of a handwheel on the column, when large-diameter gears are to be cut. Since the columns are of massive proportions, the need for an overarm is avoided, and there is a clear space above the working area to permit large-diameter gears to be readily loaded and unloaded by means of a hoist.

Hobs up to 11½-in. diameter with a maximum length of 13 in. can be employed on the machine, and the total hob shift movement obtainable is 12 in. Drive is taken from a 19-h.p. motor, and the hob speeds can be varied steplessly from 25 to 150 r.p.m. The feeds, which, again, can be varied steplessly, range from 0.014 to 0.283 in. per table rev. vertically, and from 0.003 to 0.060 in. per rev. in the radial and tangential directions. Spindle speeds and feeds can be adjusted while cutting is in progress, if required, by means of dials incorporated in a pendant control unit which can be housed in a recess in the left-hand column or swung to a convenient position. Rapid power traverses are provided for the various motions on the machine, and the 55-in. diameter table can be rotated continuously

at speeds ranging from 1 to 6 r.p.m. to facilitate setting a blank concentric with the axis of rotation.

The machine can be set for gear cutting by the Pfauter diagonal hobbing method in which vertical and tangential feeds are applied simultaneously to the hob saddle and spindle. This arrangement provides, in effect, a continuous hob shift movement so that uniform wear of the cutting edges is obtained. The ratio between vertical and tangential feeds can be varied by means of change gears. Conventional and climb hobbing can be carried out on an automatic cycle, and for



**Fig. 4. Pfauter type P. 2300 gear hobbing machine**

climb cutting, backlash between the screw and nut of the vertical feed is eliminated by a patented hydraulic arrangement.

### ACIERA TYPE TR33 CO-ORDINATE POSITIONING TABLE

Aciera S.A., Le Locle, Switzerland (Adam Machine Equipment, Ltd., St. Peter's Street, St. Albans, Herts.), have introduced the type TR33 co-ordinate positioning table shown in the drawing, Fig. 5, for use on a vertical drilling machine. It has a T-slotted working surface measuring 22 by 15½ in., with longitudinal and transverse movements of 11 and 7½ in. Adjacent to the working surface, on the left, there is a glass covered frame A, to hold an 11½- by 8-in. drawing whereon are shown the positions of holes required in the workpiece.

A master positioning plate B is attached to the under-side of the table and is provided with a number of accurately located, hardened and ground pins, as at C, which have pointed ends. The table moves freely on hardened and ground rollers in the longitudinal and transverse directions, and it is manoeuvred until a spot of light, which is visible through the drawing, appears near the selected hole. A lever D is then moved to the right so that the cam block E lifts the plunger F into engagement with the selected pin. This plunger has a mating conical recess, and the

table is thus located in the required position. The lever movement also clamps the table securely in both directions of travel.

One master plate can be provided with pins for a number of workpieces, since for each piece a drawing is used as a guide for pin selection. In one instance, for example, one plate was provided with 194 pins for 33 different workpieces. The minimum distance between hole centres is ⅜ in. It is stated that, under normal conditions, an accuracy of positioning of 0.0004 in. can be achieved. The overall height of the unit is 10¼ in., and it weighs 3 cwt.

### T.A.L. MARK 2 AIR-OPERATED CONTROL UNIT FOR MACHINE TOOLS

Recently developed by T.A.L. Numatics, Ltd., Energy Works, Leighton Buzzard, Beds., the Mark 2 equipment shown in Fig. 6 is intended to provide for remote control for a machine tool which may be operated by compressed air or a hydraulic system at 300 lb. per sq. in. maximum pressure. The unit may also be employed for controlling a vacuum system down to 30 in. Hg. It was shown on the company's stand set up for controlling various movements on a milling machine. An assembly at the right-hand end of the unit houses 12 radially-mounted valves of the lapped spool and sleeve type, which can be operated by compressed air in both directions, or in one

direction only, with spring return. These valves can be employed for controlling a maximum of six double-acting cylinders which can be brought into operation in any desired sequence.

At the end of a particular stage of the operating cycle of the associated machine, one of the cylinders operates a limit valve, with the result that compressed air is passed by means of a 4-way spool-type valve to a double-acting cylinder incorporated in the unit. Operation of this cylinder causes a central assembly to be indexed through an angle of 30 deg. to initiate the next stage in the working cycle. This

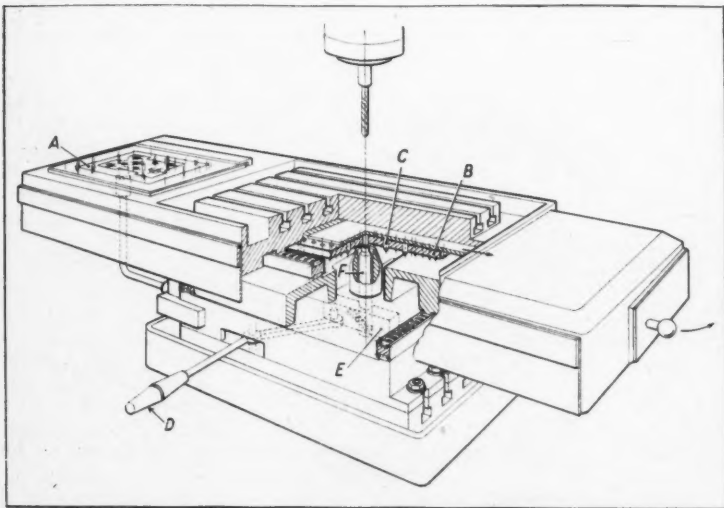
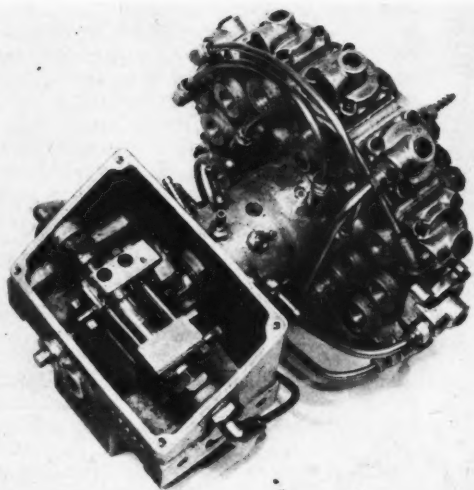


Fig. 5. Perspective sectional view of the Aciera type TR33 co-ordinate positioning table for use on a vertical drilling machine



**Fig. 6. T.A.L. Mark 2 air-operated control unit for machine tools**

arrangement ensures that one stage of the operating cycle cannot be started until the preceding stage has been completed. The unit can be supplied with holes threaded  $\frac{1}{8}$ -,  $\frac{1}{4}$ -, or  $\frac{1}{2}$ -in., to take connections for pipes for compressed air or pressure fluid.

#### **GEFRA TYPE D 2 CAPSTAN LATHE AND ADJUSTABLE BORING HEADS**

Shown in Fig. 7, the type D 2 capstan lathe built by N. V. Machinenfabriek Gefra, The Hague, Holland (Funditor, Ltd., 3 Woodbridge Street, London, E.C.1), has a centre height of 4 in., and the length of the bed is 29½ in. A lever-operated parting-off slide is mounted on the vee and flat bedways. Drive is taken from a 2-speed motor, of 1.3/2.2 h.p., through a flat belt and stepped pulleys, and the 8 spindle speeds obtainable in each direction range from 175 to 3,000 r.p.m. Mounted in angular contact ball bearings at the nose end, and a roller bearing at the rear, the headstock spindle is bored  $\frac{1}{2}$  in. diameter, and will take collets up to  $\frac{1}{2}$  in. capacity, also a 5-in. diameter 3-jaw chuck. There is a single lever on the headstock for opening and closing the collet and operating the clutch and spindle brake, also separate switches for selecting the motor speeds and reversing the spindle drive. A type D 1 lathe of similar capacity is available, which has a lever-operated tailstock, and a screw-operated swivel compound slide fitted with front

and rear tool-posts. The spindle is bored 1.1 in. diameter, and will take a 3-jaw chuck only.

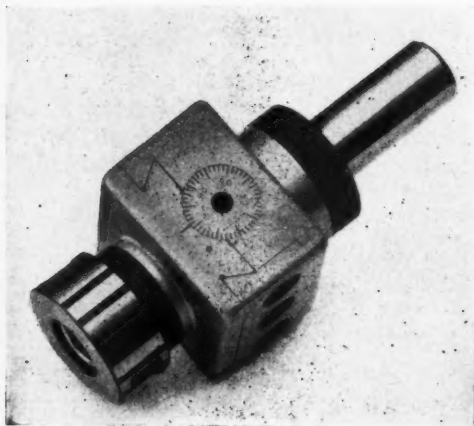
The Gefra type D 13 motor-driven spindle unit can be employed as an independent item, or it can be mounted on a bed member which has vee and flat guideways for a saddle and tailstock, to form a lathe with a centre height of 3.94 in. This bed member is available in different lengths which enable a maximum of 7.87 or 13.78 in. to be admitted between centres mounted in the spindle and tailstock. The centre height of the spindle unit is 5.9 in., and drive is taken from a 0.8-h.p. motor through a belt and stepped pulleys. Spindle speeds of 1,300, 2,600 and 4,000 r.p.m. are provided in either direction. The spindle is bored 0.79 in. diameter, and will take collets up to 0.47 in. capacity.

Adjustable boring heads are made by the company in two sizes, and an example is shown in Fig. 8. The cutter slide can be adjusted for a maximum distance of  $\frac{1}{4}$  in. on the smaller boring head, and 1½ in. on the larger size, and a micrometer dial is fitted for accurate setting. Each head can be supplied to take a  $\frac{1}{2}$ -in. diameter boring bar or an off-set bar,



**Fig. 7. Gefra type D 2 capstan lathe**





**Fig. 8.** One of the Gefra adjustable boring heads, which are available in two sizes

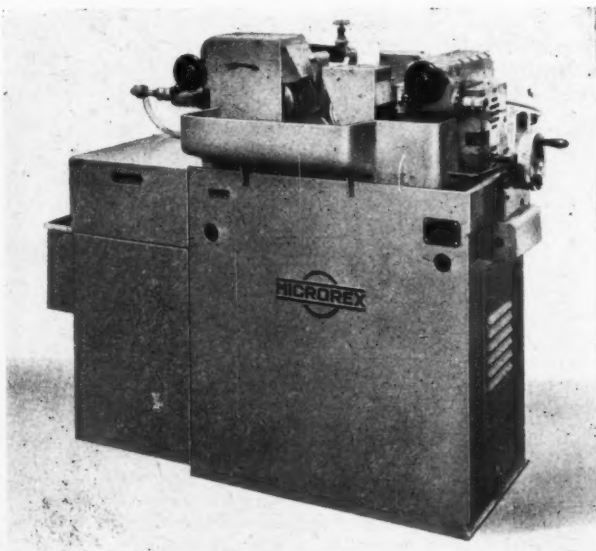
which will accommodate 6-mm. (0.236-in.) square tool-bits. When an off-set bar is fitted, cuts can be taken on diameters up to 6 or 7½ in., depending upon the size of the head. Alternatively, the heads can be supplied, as shown, to take interchangeable rubber collets with steel gripping pieces. Boring bars of different diameters from 0.193 to 0.480 in. for the smaller head, and from 0.098 to 0.748 in. for the larger size, can then be held. With a third design, the bore for accommodating a boring bar or a rubber collet is off-set from the centre line of the shank, when the cutter slide is set in the central position, by 8 mm. (0.315 in.) on the smaller head, and 12 mm. (0.472 in.) on the larger size, to give an increased working range. There is a threaded hole in the body to take interchangeable shanks of different types.

#### **MICROREX NO. 00 CENTRELESS GRINDER**

Workpieces up to 1 in. diameter can be handled on the Microrrex No. 00 centreless grinder built by Fabrications Mécaniques de Precision, Saint-Etienne (Loire), France (Stanley Howard, Ltd., 73 Devon Street, Saltley, Birmingham, 7). Shown in Fig. 9, the machine will take grinding wheels up to 12 in. diameter by 2½ in.

wide, and the diameter of the control wheel is 7½ in. Mounted in water-cooled taper roller bearings, the grinding spindle runs at a speed of 2,000 r.p.m., and may be driven from a motor of 4 or 5 h.p. The spindle for the control wheel is mounted in taper roller bearings, and is driven by a ¼-h.p. motor, through a 2-speed gearbox which gives speeds of 25 and 280 r.p.m. Roller bearing guideways are provided for the control-wheel head and it can be tilted through a maximum of 6 deg. for through grinding operations, and swivelled to enable taper grinding to be carried out. There are separate hand-operated dressing attachments for the grinding and control wheels, and the slides which carry the diamond holders run on anti-friction guideways. Coolant is delivered through the diamond holder on the attachment for dressing the grinding wheel, and the other attachment can be adjusted for angle independently of the control-wheel head.

In-feed for a distance of ½ in. can be applied to the control-wheel slide by a lever, and settings for depth of cut are made by micrometer drum through a hardened and ground screw. In addition, feed can be applied in increments of 0.00004, 0.00008, and 0.00016 in. by pressing a push-button. Mounted on hardened steel guide pieces, the work rest can be fastened to the control wheel slide or the bed, and an attachment which incorporates two fixed guides and two adjustable guides



**Fig. 9.** French-built Microrrex No. 00 centreless grinder



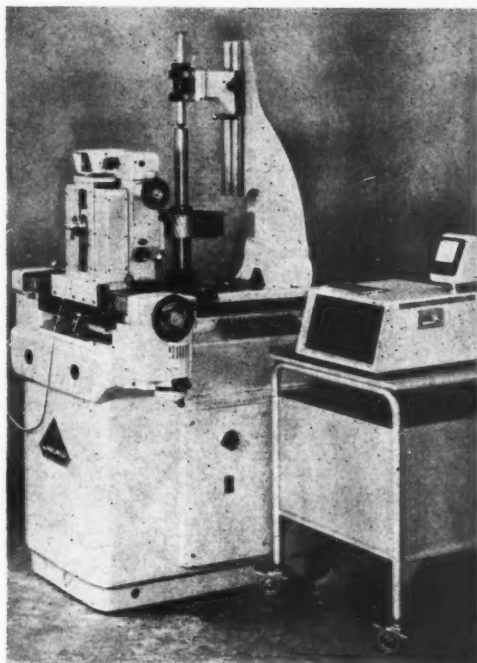
can be fitted to receive workpieces that have been ground by the through-feed method. A workpiece ejector can be supplied for attachment to the work rest when plunge grinding is to be carried out, and is automatically brought into use during the cycle by movement of the in-feed lever. A magnetic coolant separator is available.

# **KLINGELNBERG TYPE PFS 600 INVOLUTE AND HELIX ANGLE TESTING MACHINE**

In Fig. 10 is shown the type PFS 600 involute and helix angle testing machine made by W. Ferd. Klingelberg Sohne, Remscheid, Germany (Sykes Machine Tool Co., Ltd., The Hythe, Staines, Middlesex). This machine will normally handle gears up to 23 in. diameter, with modules from 0.75 to 20 mm. and helix angles from 0 to 90 deg., and also enables worms to be checked for lead angle. An additional work-slide attachment can be provided which permits gears up to 31½ in. diameter to be accommodated. Gears with a maximum face width of 6.29 times the cosine of the helix angle, and worms with lengths up to 6.29 times the sine of the lead angle can be checked on the machine. Mandrels, and gears with integral shafts up to 26½ in. long can normally be admitted, but a special centre attachment can be provided which gives a length capacity of 33 in.

When the machine is in operation, the gear to be tested is turned by the rolling action between a disc mounted on the work spindle, and a straight-edge on a horizontal slide, which are held in contact with each other under a pre-set pressure. The same disc can be used for checking gears with base circle diameters which differ by a maximum of  $\pm\frac{1}{2}$  in. from the nominal value. When the gear is to be tested for helix angle, the slide which carries the measuring head is traversed in the vertical direction, and motion is simultaneously imparted to the horizontal slide by the "helix guide". In this way, the gear is turned, and the stylus pin on the measuring head is traversed across the face in contact with the flank of a tooth. The helix guide can be set to suit the helix angle of the gear to be tested with the aid of optical measuring equipment which gives readings to 1 sec. of arc.

The vertical and horizontal slides are mounted on ball-bearing guideways which ensure sensitive movements, and they can be traversed by hand, or automatically at steplessly-variable speeds. A mechanical-type recording unit can be provided which gives a magnification of 500 $\times$ , and the ratio between the movement of the graph paper and the measuring slide can be varied from 1:1 to 8:1 in four steps. Alternatively, the machine



**Fig. 10.** The Klingelberg type PFS 600 involute and helix angle measuring machine is here shown set up for use in conjunction with an electrically-operated recording unit

can be used in conjunction with an electrically-operated recording unit which is mounted on a separate wheeled trolley, as shown. Magnifications from 100 to 1,000 $\times$  are then obtainable, and the ratio between the traverse movement of the graph paper and the measuring slide can be varied in 6 steps. A high-sensitivity tracer head can be employed with the electric recording unit, which provides a magnification of 10,000 $\times$ , and enables gear teeth to be checked for surface finish.

# **DÉRAGNE FINE BORING MACHINE**

In Fig. 11 is shown the Diamanta 3 double-ended fine boring machine built by Ets. Déragne Frères, Villeurbanne (Rhône), France (Stanley Howard, Ltd., 73 Devon Street, Saltley, Birmingham, 7). This machine can be supplied with numbers of boring spindles from 2 to 8, and enables cuts to be taken on diameters up to 8 in. Drive to the boring heads mounted on each bridge may be taken from a single-speed or a 2-speed

motor, fitted with an electro-magnetic brake, and spindle speeds in the range from 250 to 4,000 r.p.m. can be obtained by means of interchangeable pulleys. Plain bearings or taper roller bearing, or special ball bearings for high-speed operation, can be provided for the spindles, and the boring heads can be mounted in various positions on the bridges to suit the work to be handled.

Measuring 13½- by 27½-in., the work-table has a maximum travel of 23½ in. on vee guideways, and adjustable feeds for rough and fine boring, also rapid power traverse, are provided hydraulically. The distance between the bridges is 31½ in. A variety of automatic cycles can be obtained, which may provide, for instance, for taking a rough boring cut in the work with spindle heads mounted on one bridge, and a finishing cut in the same bores with the other heads. If required, workpieces may be loaded into a fixture mounted on the table while boring of other components is in progress. Rotary work-tables can be provided, also a transfer-type table, the cross movement of which may be imparted hydraulically or by compressed air.

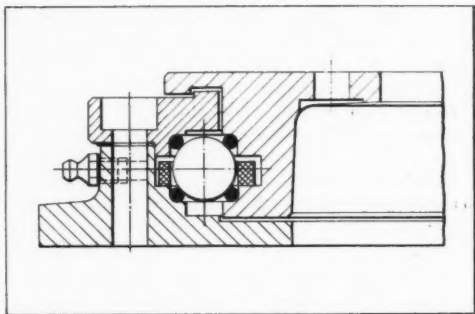
A type 1H2 double-ended machine of similar design is available, which has a capacity for taking cuts in bores up to 5 in. diameter, and will accommodate a maximum of six spindle heads. Up to six spindle speeds in the range from 450 to 5,500 r.p.m. are obtainable by means of interchangeable

pulleys. The distance between the bridges is 27½ in. and the 9½- by 22½-in. work-table has a maximum travel of 13½ in.

The company's range also includes Diamanta 1 and Diamanta 2 single-ended fine boring machines.

## New Roballo Wire-race Ball Bearings

Roballo Engineering Co., Ltd., 43 Dover Street, London, W.1, have recently introduced a range of six new wire-race ball bearings, with diameters from



Sectional view of a typical Roballo wire-race ball bearing from a new range

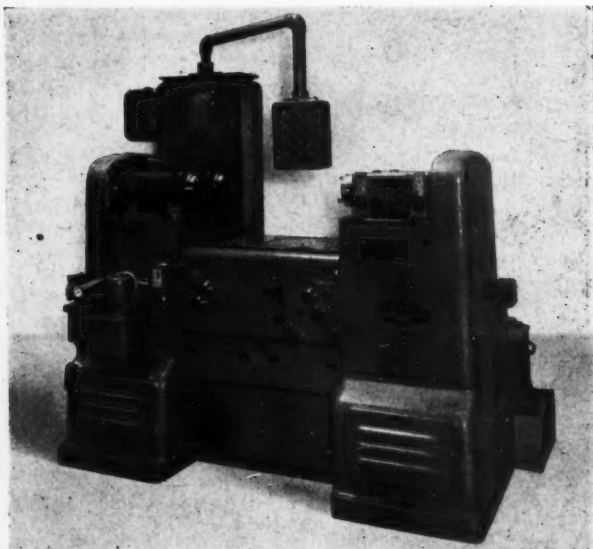


Fig. 11. Déragne Diamanta 3 double-ended fine boring machine

18 to 40 in. (see also *MACHINERY*, 91/1435—20/12/57 and 96/192—27/1/60), which are intended for supporting indexing tables on machine tools and similar applications, and a sectional view of a typical unit is shown in the figure.

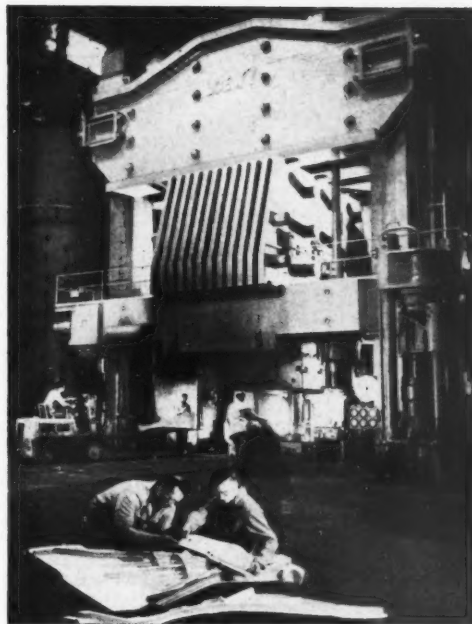
It is stated that, since the balls in each of these bearings are in contact in four places with the tracks on the spring steel wires, which are ground to suit the radius, high rigidity is obtained and accuracies of the order of 0.002 in. can be maintained for radial and axial run-out. The wires are inserted in accurately-machined grooves in medium carbon steel backing rings, which are flanged to enable them to be bolted directly to the associated machine members.

STILL CAMERAS to the total value of £121,000 were produced during the first quarter of this year.

# Developments in the Forging of Materials for Service at High Temperatures

TO MEET THE REQUIREMENTS for a variety of components for missiles and space vehicles, investigations have been carried out by the Wyman-Gordon Co., Worcester, Mass., U.S.A., in connection with the forging of metals and alloys which will retain the necessary degrees of strength at high service temperatures. Depending on requirements, parts for these applications are forged from three classes of materials: (1) the medium-high-temperature alloys, such as INCO 901, V57, and A286; (2) the nickel-base "superalloys," including Astroloy, Rene 41, and Waspaloy; and (3) the refractory metals—molybdenum, columbium, and possibly tantalum.

Parts of the medium-high-temperature alloys are



being forged on a production basis for service in the 1,000- to 1,200-deg. F. range. When the service temperature exceeds 1,200 deg. F., but is below 1,800 deg. F., the nickel-base "superalloys" are applicable. For service at temperatures above

1,800 deg. F., the refractory metals must be employed. Experience in forging the refractory metals is, however, limited, and although there are some current applications, there are still many fundamental processing problems to be solved. Application temperature ranges for forgings of the various metals and an indication of the present situation as regards production are given in Fig. 1.

Closed-die forgings of the iron- and nickel-base alloys for high service-temperature applications (above 1,000 deg. F.) are made with the workpieces heated to

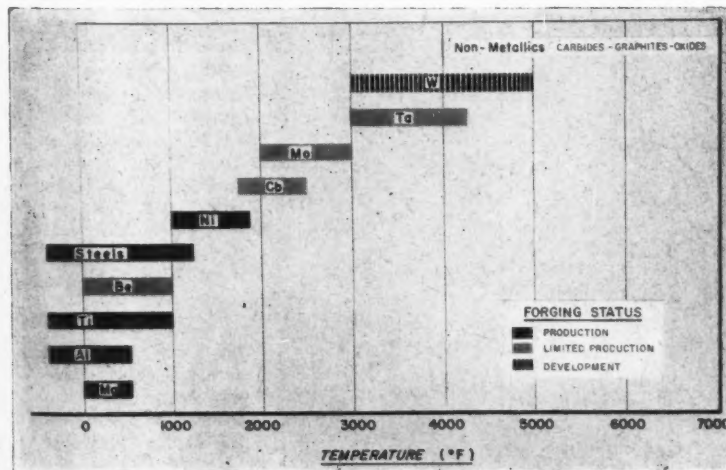


Fig. 1. Chart showing the service temperature ranges for forgings of various metals. The forging status of each metal is also indicated

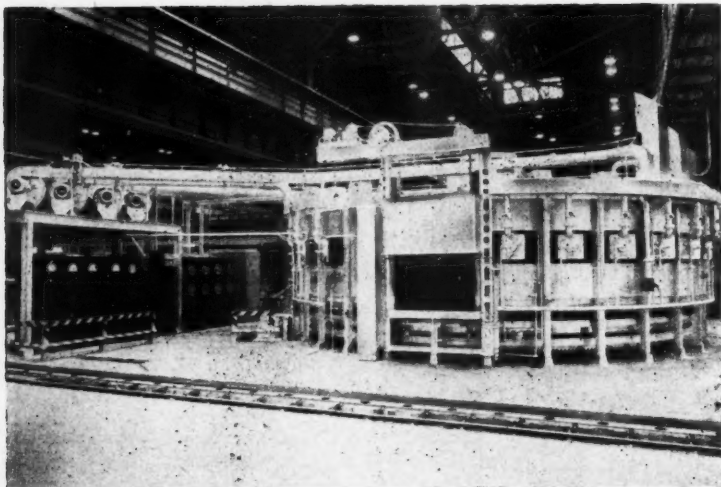


Fig. 2. Rotary-hearth furnace for heating stock for forging. Of 30 ft. diameter, it is equipped with instruments that maintain workpiece temperature within close limits

temperatures in the 1,600 to 2,100 deg. F. range. Furnaces used to heat the stock for forging at the company works are either of the conveyor type or of the rotary-hearth type shown in Fig. 2. Standard tool-steel dies, preheated to about 600 deg. F., are employed for these alloys as well as for the refractory metals. At these forging temperatures, parts made of iron- and nickel-base alloys are shaped (either on presses or hammers) and removed from the dies before the latter are damaged. In the heading illustration a part is being placed in closed

the Air Force Heavy Press Programme.

Since the superalloys and refractories have greater strength at higher temperatures they are necessarily more difficult to forge, and the dies wear more rapidly. Die wear is greatest with the refractory metals, some of which are now being forged experimentally at temperatures in excess of 2,500 deg. F. Methods of improving dies are being studied, but the problem is not serious at present, since the number of forgings being produced from the refractory metals is insufficient to make die wear significant. Dies used for iron- and nickel-base alloy forgings do not normally show an amount of wear that could be regarded as excessive.

Contour machining of a closed forging die

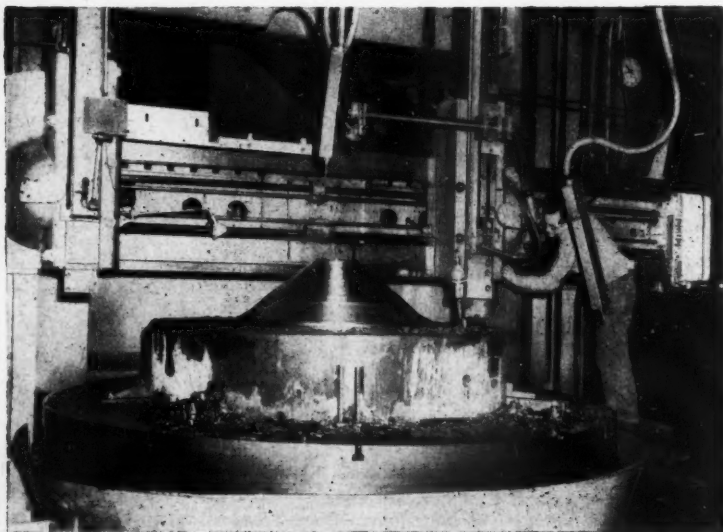
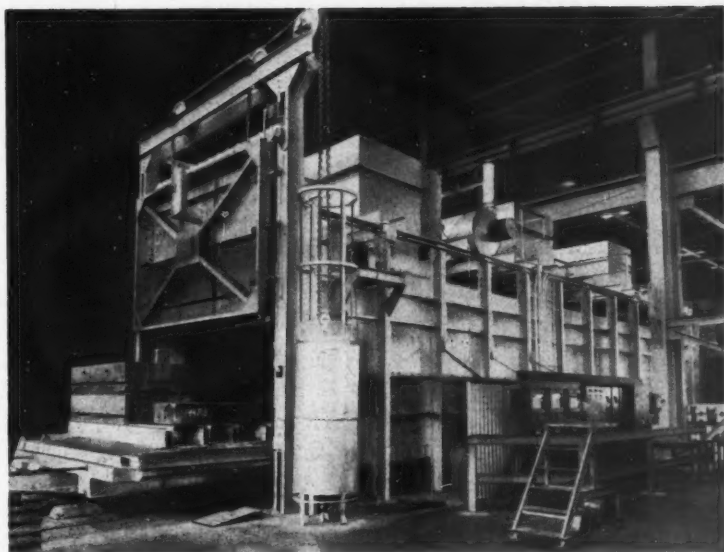


Fig. 3. Tracer-controlled contour machining is here seen in progress on a member for a closed-die for forging a missile nose cone. The completed die set was used on the press in the heading illustration



**Fig. 4.** Large closed-die blocks are pre-heated to temperatures up to about 600 deg. F. in this car type furnace



member on a vertical boring mill operated under tracer control is seen in progress in Fig. 3. When completed, the die set in which this member was incorporated weighed 70 tons and was used on the 50,000-ton press to forge nose cones for missiles. Die-blocks of this size are heated prior to use in a car type furnace, as shown in Fig. 4.

#### VARIOUS VACUUM-MELTING METHODS ARE USED

At present many of the parts which are being forged for high-temperature service are discs or wheels with cross sections of various contours. They are employed, for example, in jet aircraft as turbine wheels or compressor rotors. To enable satisfactory forgings to be obtained, careful control of processing must start with the melting of the metal. Most of these metals are melted in vacuum by one of several different methods and cast into ingots. For example, induction vacuum-melting techniques have been developed for the nickel-base super-alloys, whereas ingot of columbium are produced by vacuum

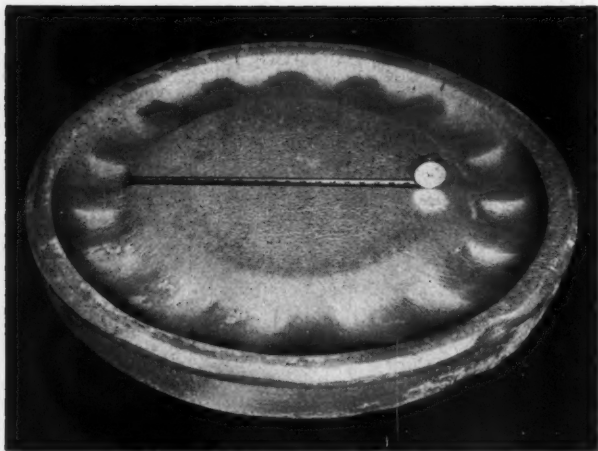
consumable-electrode melting of electron-beam melted metal.

Since the nickel-base superalloys are extremely complex, they must be melted very carefully and then handled in such a manner as to avoid contamination before they are cast. In addition, they must generally be cast in special moulds, to minimize segregation of the various phases.



**Fig. 5.** Direct-reading spectrograph for analyzing the composition of forging materials. Reliable results are quickly obtained





**Fig. 6.** This columbium part has been forged in closed blocking dies and is ready for the finishing operations

After they have been cast, ingots are clogged or bloomed, to reduce them to the required cross-section, and the material is then cut into billet lengths, for delivery to the forging plant.

Billets are generally inspected ultrasonically, and test pieces taken from various positions are etched and examined microscopically for phase segregation, exogenous inclusions, or other faults. Chemical composition, engineering properties, and forging characteristics are also determined. Samples from a billet, or a particular heat of material, are forged and tested to ensure that the metal can be properly worked before production is started. Then, during various stages of the production cycle, the material may again be ultrasonically inspected, etched, or checked with a dye penetrant to detect any defects which may have developed in the piece during forging. A direct-reading spectrograph (Fig. 5) is normally employed for determining chemical composition, since it is both rapid and dependable. If inclusions or discontinuities are present in a billet it is rejected, since the majority of discontinuities do not heal effectively during forging.

At this stage, engineers decide how

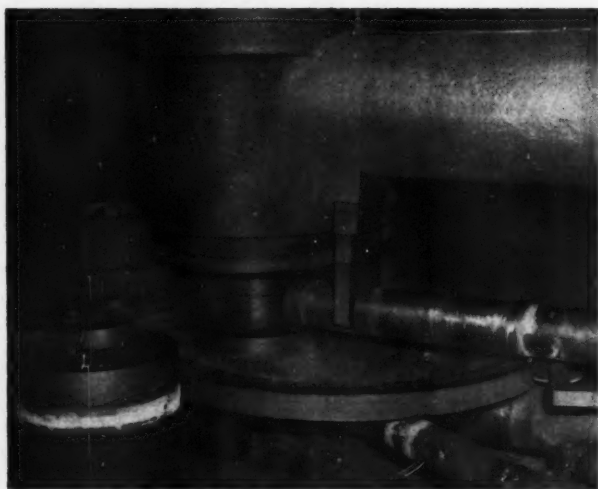
much metal is required to forge a particular part, allowance being made for certain losses. A typical turbine-wheel forging may require a 300-lb. billet.

Initially, the heated billet is placed between flat dies and upset to a "pancake" shape. Subsequently, it is forged in closed dies. As many as four different closed dies may be required for a turbine wheel forging, depending on its complexity. When four closed dies are employed, the operation stages are normally termed

pre-blocking, blocking, pre-finishing and finishing, each successive die serving to produce a more closely-defined contour.

Simple forgings do not require so many stages, and may often be processed directly in a finishing die. For most wheel contours, however, some blocking and a pre-finishing operation are needed. In Fig. 6, a workpiece of columbium alloyed with 1 per cent of zirconium is shown after it has been forged in closed blocking dies and is ready for the finishing operations.

Smaller turbine wheels are frequently forged on hammers which have sufficient power for such operations. For large-diameter wheels, however,



**Fig. 7.** A 40-in. diameter ring for a jet aircraft engine is here being roll-forged

**Fig. 8. A turbine-shaft forging of a medium-high-temperature steel is here seen set up for the final operation in closed dies on 20,000-lb. hammer**



heavy press equipment must be employed. The Wyman - Gordon Co. operate six closed-die forging presses with capacities ranging from 6,000 to 50,000 tons. In addition, forging operations are performed on special equipment such as the ring-rolling machine seen in Fig. 7. The rolls of this machine rotate the workpiece and exert pressure whereby it is shaped progressively. A 40-in. diameter ring for a jet aircraft engine is here being roll-forged.

A turbine-shaft forging of A-286 steel—one of the medium-high-temperature application alloys—is shown in Fig. 8 ready for the finishing operation in closed dies set up on a 20,000-lb. hammer. The part, which is cone-shaped, is 16½ in. long by 21 in. diameter at the large end, and weighs 233 lb.

When forging the nickel-base superalloys, tem-

peratures must be carefully controlled within very narrow ranges. If a part is forged at a temperature either above or below the working range, it is liable to crack or break. With these materials, moreover, failure may occur at any time during a forging operation if there is even a slight defect which was not detected at the previous inspection. In general the superalloys and refractory metals, being difficult to work, are extremely sensitive to flaws and will fail during processing at an earlier stage than would materials with better forging characteristics.

Apart from the narrowness of the temperature range for forging, the amount and rate of deformation appear to be critical factors with some of the nickel base superalloys. These factors are not only related to the alloy but often also to the form of the workpiece. The development of improved mechanical properties depends both on the metallurgical composition and on the manner in which the parts



**Fig. 9. This ring is one of two cut from a composite wheel-type forging of Rene 41, a nickel-base superalloy. On removal from the 50,000-ton press, the composite forging, of 44 in. diameter, weighed 712 lb.**



Fig. 10. This refractory-metal forging has a "diameter" of 36 in., is 14 in. high, and weighs 1,300 lb. The material is columbium with 1 per cent zirconium

MECHANICAL PROPERTIES OF FORGINGS MADE FROM THE NICKEL-BASE SUPERALLOY ASTROLOY		
	Room temperature	1,400 deg. F.
Ultimate strength, lb. per sq. in. ....	190,000	150,000
0.2 per cent yield strength, lb. per sq. in. ....	138,000	122,000
0.02 per cent yield strength, lb. per sq. in. ....	127,000	110,000
Elongation, per cent on 2 in. ....	8	10
Reduction in area, per cent ....	10	12



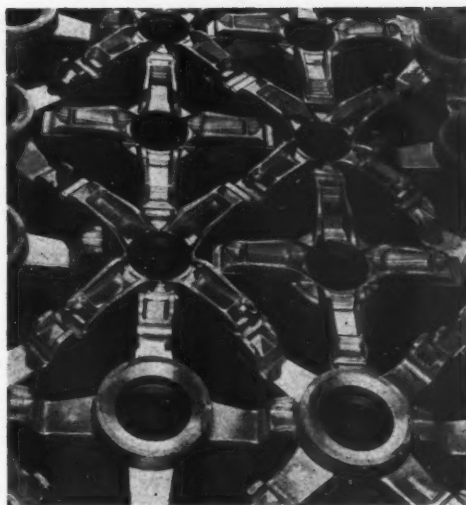
Fig. 11. Large closed-die aluminum forging for the Convair 600 4-engined jet aircraft. This bulkhead, which is 12 ft. long, weighs nearly 800 lb.

are worked. Final part structure, in other words, is determined largely by the manner in which the material has been deformed. The superalloys normally require more forging stages than the more easily worked metals.

Turbine wheels for certain propulsion systems are being forged from many of the nickel-base superalloys. In one instance, 50-in. diameter wheels made by the Wyman-Gordon Co. from Rene 41 have the following guaranteed minimum mechanical properties at 1,400 deg. F.: ultimate strength, 135,000 lb. per sq. in.; 0.2 per cent yield strength, 115,000 lb. per sq. in.; 0.02 per cent yield strength, 100,000 lb. per sq. in.; elongation on 2 in., 13 per cent; and reduction in area, 18 per cent.

One of two large rings which were machined from a 44-in. diameter, 712-lb., composite wheel type forging of Rene 41, made on the 50,000-ton press, is seen being checked in Fig. 9. Recently developments in connection with the forging of Astroloy have enabled wheel shapes up to 40 in. diameter to be produced within the minimum mechanical properties indicated in the accompanying table. Both Rene 41 and Astroloy were developed by the General Electric Co.

**Fig. 12.** Magnesium forgings for helicopters, each of which weighs 81 lb. and has a maximum dimension of 35 in. They were made in a closed-die on an 18,000 ton press



#### REFRACTORY METALS ARE COMING INTO USE

As was mentioned earlier, refractory metals must generally be employed when the forging is to be used at a temperature of 1,800 deg. F. and above. Nickel-base superalloy parts can sometimes be employed, where stresses are not severe, up to about 2,000 deg. F., but at higher temperatures only a refractory metal can be of any reasonable service. Molybdenum forgings are being made on a production basis for solid fuel rocket motors. Columbium forgings, containing 1 per cent of zirconium, and processed at 2,250 deg. F., have been made in sizes up to 36 in. diameter by 14 in. high, and weighing 1,300 lb. (Fig. 10). Tantalum, tantalum tungsten, and tungsten have also been forged on an experimental basis. Potential maximum application temperature for tungsten forgings is 5,000 deg. F.

Forging temperatures for the refractory metals are so much higher than those normally employed that special heating equipment and different handling techniques are necessary. Refractory-metal parts may be produced directly by powder metallurgy methods, the workpieces being machined from the compacts. Alternatively, forgings can be made either from compacts or from ingots cast from vacuum consumable - electrode melted material.

The refractory metals have one drawback in common, they lack oxidation resistance. In the case of molybdenum, oxidation causes deterioration of the metal, and columbium

will crack due to gas diffusion along grain boundaries. Coating is the only method of protection that has so far offered prospects of success. Attempts have been made to alloy these metals, but with very little benefit as far as oxidation resistance is concerned. Although coating appears to offer a practical solution, coatings themselves present many problems. A test to determine the effectiveness of coatings on columbian forgings



**Fig. 13.** This die, for a magnesium helicopter forging, is set up for machining under tape control



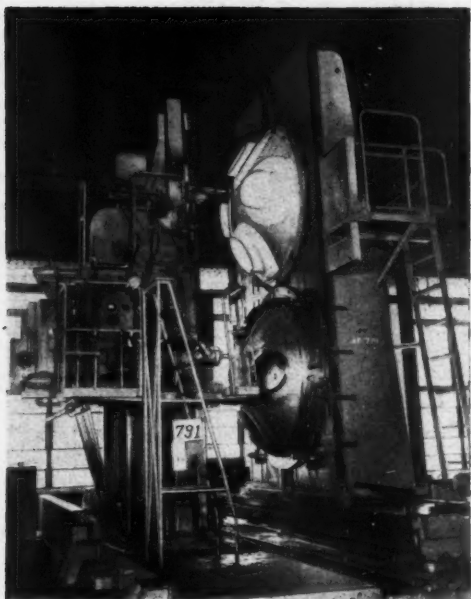


Fig. 14. A forged end closure for a rocket motor case is here being contour-milled on a Pratt & Whitney Keller die sinking machine

showed that oxygen-gas penetration (which causes cracking along grain boundaries) was reduced from 0.07 in. for uncoated to 0.05 in. for coated parts. The specimens were heated for two hours at 2,100 deg. F. for the test.

Graphite, the accepted lubricant for forging, has been the subject of much study. It has been found that coefficients of friction, when using graphite, can be greatly reduced by allowing oxygen to be absorbed along the interlaminar layers. Some recently compounded graphite type lubricants have additives that produce an atmosphere which assists interlaminar absorption of oxygen and thus reduces friction.

Beryllium—with its high modulus of elasticity, low density, reasonable heat resistance, and excellent strength-to-weight ratio—is destined to become an important metal for missile and space-vehicle construction. Since cast ingots of beryllium have limited workability, most parts are made from powdered beryllium either by press forging or by vacuum press sintering. Forged parts, on the average, have an ultimate strength of 53,000 lb. per sq. in., a 0.2 per cent yield strength of 40,000 lb. per sq. in., and an elongation of 2.4 per cent when tested at room temperature. Vacuum

press-sintered beryllium has an ultimate strength of 40,000 lb. per sq. in., a 0.2 per cent yield strength of 30,000 lb. per sq. in., and an elongation of 1 per cent under the same conditions. At temperatures between 1,000 and 1,500 deg. F., however, forged and sintered beryllium have about the same properties. At present, forgings of beryllium up to 72 in. diameter can be produced.

Titanium, with its high strength-to-weight ratio, is also an important metal for missiles and aircraft. It is expected that with continued development it will be possible to produce closed-die forgings of B120VCA titanium alloy with yields strengths up to 200,000 lb. per sq. in. and an elongation of 5 per cent. End enclosures of 38 in. diameter have been forged for rocket motor cases. Titanium forgings have also been produced for such parts as pressure bottles for liquid rocket engines.

One of the advantages of the heavy presses is that large, complex, one-piece parts of the light metals, such as aluminium and magnesium, can be readily forged, the cost of joining many smaller members together being thus avoided. A large closed-die aluminium forging for a commercial aircraft is seen being placed in an ultrasonic inspection tank in Fig. 11. The forging is 12 ft. long and weighs approximately 800 lb. The closed-die forgings illustrated in Fig. 12 are 81-lb. magnesium components (35 in. across) for helicopters. They were made on the third largest forging press (18,000 tons) at the Grafton, Mass., plant.

Machining of dies, as well as of forged components, is receiving much attention. Die-sinking on an experimental basis is being performed under numerical control and by spark machining. A die is seen set up in Kearney & Trecker numerically-controlled machine for contour milling in Fig. 13. Chemical milling is also being employed for certain purposes. Typical of the more conventional operations carried out is the contour machining of a forged closure for a rocket motor case on a Pratt & Whitney Keller die-sinking machine, as seen in Fig. 14.

**POLYTHENE-COATED PAPER SACHETS.** Special plant has been installed by Stonehouse Paper & Bag Mills, Ltd., Lower Mills, Stonehouse, Gloucestershire, for the manufacture of polythene-coated sachets in a variety of different papers and overall sizes.

These sachets are particularly intended for packing articles that would be affected by damp, also items to which oil or grease must be applied for protection against corrosion, such as instruments, tools, and engineering components. After they have been filled, the containers can be heat-sealed.



# NEWS OF THE INDUSTRY

## Yorkshire

**ANDERTON SPRINGS, LTD.**, Clyde Street, Bingley, inform us that there has been a steadily growing demand for their range of standardized circlips from both the home and export markets during the past year, and that trade has increased to such an extent that a considerable works expansion programme has been undertaken. An addition to the Clyde Street premises, which provides a 50 per cent increase in capacity, has recently been completed and this new section is now in full production. A new plating plant, which will afford improved facilities for electrodeposition of nickel, cadmium, zinc, and tin, is shortly to be installed. A heavy auto-ring coiling machine for handling materials up to 0.200 in. diameter has been purchased, and other specialized machinery which is shortly to be added to the plant will include 4-slide automatic forming machine for producing spring pressings. In addition, a number of heavy type presses is on order to meet the requirements of the 1962 expansion programme.

A new design of circlip pliers has been developed and it is hoped to start production shortly. We are informed that a new catalogue containing 35 pages of data sheets and information on the company's range of products has recently been issued, copies of which are available on request.

**THE DEE-KAY ENGINEERING CO., LTD.**, Victoria Works, Bingley, makers of jigs, fixtures, press tools, and dies, report that their new toolroom has now been completed, and is in full operation, the plant having been installed during the recent holiday period. A fully air-conditioned room is being prepared to house the precision equipment used by the company, including jig borers, jig grinders, and optical profile grinders.

To answer the increasing calls on the services offered by the company, it is planned to install a number of additional toolroom machines and other units next year, apart from normal replacements.

**INDIVIDUAL TOOLS, LTD.**, Seven Dial Works, Church Street, Bingley, report that their works are maintaining a steady output of various types of press tools and special sheet metal working machinery. A number of internal flanging

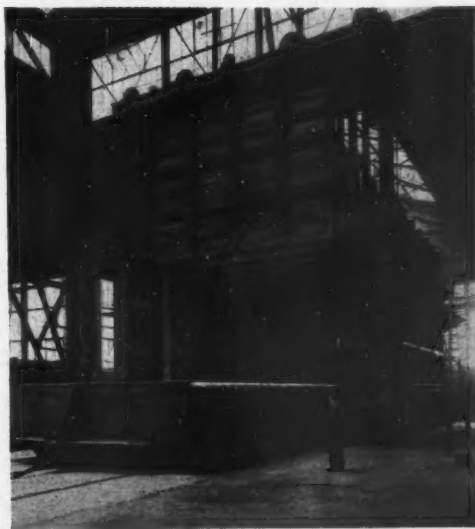
machines has recently been despatched for use in the domestic appliance manufacturing industry.

**ELLISON SPRING CLIPS, LTD.**, Harden, near Bingley, inform us that their new factory is now in full operation and that production has been substantially increased. Owing to the heavy demand from both the home and export markets, however, additional plant is being provided to enable output to be further expanded. Equipment recently installed has included a 500-ton capacity press.

**KEIGHLEY GRINDERS (MACHINE TOOLS), LTD.**, Aireworth Works, Aireworth Road, Bradford Road,



Installed at the Victoria Works of Harland & Wolff, Ltd., Queens Island, Belfast, this large furnace is employed for stress-relieving operations on weld-fabricated bed plates and scavenge belts for marine diesel engines, for example. Supplied by Priest Furnaces, Ltd., Middlesbrough, the furnace will accept a workpiece measuring 32 ft. long by 19 ft. wide by 13 ft. high, and the wheeled bogie seen in the foreground, whereby it is loaded, has a carrying capacity of 70 tons



Keighley, report a sustained demand for their range of precision grinding machines. We are informed that approximately 40 per cent of output is for export, and that orders are in hand from Poland, France, Germany, Canada, India, and Australia. This company recently showed products in Moscow and Poland, and we may note that a number of machines is also to be displayed at a forthcoming exhibition in Yugoslavia.

It is stated that the hydraulic system on the K.L.G.G. gauge grinding machine has recently been modified with outstanding results. The numerous machines seen in the course of production in the works included a number of crank-pin grinders, and a universal grinder with a capacity of 18 in. diameter by 72 in. long. A new fitting and assembly bay with an area of some 5,000 sq. ft. is at present nearing completion.

LANDIS LUND, LTD., Eastburn Works, Cross Hills, inform us that the volume of orders and enquiries for their precision grinding and fine boring machines is being maintained at a high level, and that export orders are at present in hand for Argentina, Brazil, Russia, Israel, India, Italy, Poland, Spain, South Africa, France, and Switzerland. Four machines were shown at the

7th European Machine Tool Exhibition in Brussels, and comprised a Landis Lund Gardner 2H30-30-in. double-spindle disc grinder equipped for finishing the side faces of bearing races; a Landis Lund Precimax Type FB 2 fine borer, tooled for boring, facing and chamfering operations on motor vehicle differential housings; a Landis Lund 16-in. Type DH crankpin grinder arranged for operations on crankshafts for six-cylinder motor car engines; and a Landis Lund 5-in. Type DH cam contour grinder which was shown set up for finishing the cam profiles on a camshaft for a four-cylinder engine. In addition to the above, a wheel-head for a grinding machine, equipped with the Landis profile dresser with a rotary diamond tool, was exhibited, and will be described in a subsequent issue of MACHINERY.

Other machines at present in production include a type MPB 12 by 24 plain grinder with a hydraulically-operated profile dressing attachment for the wheel, and two type R plunger grinders, each with an angular wheel-head mounted on a base of fabricated construction. Each of these machines will be provided with work loading and cycle control equipment.

R. SUTCLIFFE.

## National Engineering Laboratory

Details of the work that is being undertaken and the progress that is being made by the National Engineering Laboratory, East Kilbride, Scotland, are given in the Annual Report\* for 1960, which is now available. Since the D.S.I.R. established the N.E.L., a new programme of Government sponsored research has been directed towards helping the engineering industries to improve their products and processes, and the N.E.L. can now claim to be one of the leading centres for engineering research in this country. During the early years of its existence, great efforts were made to provide the laboratory with extensive research facilities, to develop novel research rigs and measuring techniques, and to build up an experienced staff of scientists and engineers. From the outset, the laboratory was engaged in both basic and applied research, and the policy pursued is now bearing fruit.

In the report, attention is drawn to three particularly successful projects—the automatic correction of errors in machine tools, the development of hydrostatic power transmissions, and the cold

extrusion of steel. In two instances, there has been an encouraging response from industry.

In the machine tool field, David Brown Industries, Ltd., have collaborated with N.E.L. in applying moiré-fringe techniques to the automatic correction of errors in the table drive of a standard gear hobbing machine. There are many other potential applications of this system, and the further collaboration of industry would be welcomed.

The machine tool industry has also shown considerable interest in the N.E.L. hydrostatic power transmission applied to a vertical boring machine. Another hydrostatic transmission system developed by the Laboratory is being manufactured, under licence by several British firms, and two companies in the U.S.A. have applied for manufacturing rights. In addition to applications to machine tools and motor vehicles, these transmission systems are of considerable significance in many fields, including marine propulsion, crane haulage, coal cutting and earth moving.

The Laboratory is now assisting industry in the design of tooling for relatively simple cold-extruded products, and further work on more complicated

\* National Engineering Laboratory Annual Report, 1960; H.M. Stationery Office; Price 5s. 0d.

shapes is in progress. Few British firms have introduced this process, although considerable interest has been shown abroad, and it is urged that British industry should sponsor design studies, to be confirmed by experiment, for the production of particular components.

Work has been undertaken relating to the fatigue of metals at high temperatures, and is particularly important in relation to aircraft gas turbines, which operate under fluctuating stresses at high temperatures. Current investigations are concerned, for example, with the high-temperature fatigue properties of brazed joints, such as are used in one of the methods of attaching rotor blades. Work is also being carried out to provide information on the fatigue strength of hollow blades produced by different methods.

A substantial part of the Laboratory's efforts is directed to background research, and although the results may not be of direct or immediate interest, the application of such work may be of importance in the future. One of the most important developments in this field is the production of new materials, using very high pressures and temperatures. The N.E.L. has proved its equipment by making artificial diamonds from graphite, and further studies are being pursued in connection with the nickel-carbon system at high pressures. Later stages of this work are likely to be of great significance for industry, since the Laboratory may not only be able to produce new materials, without natural counterparts, but may also be able to synthesize materials with particular combination of desirable properties.

The Laboratory has determined the relative rate of crack growth for a wide range of engineering materials. This work is aimed to provide a fundamental explanation of fatigue damage and failure, and to define the qualities required to resist such damage.

Tests have been carried out in connection with the lubrication of hypoid gears, using extreme-pressure lubricants, at running speeds equivalent to road speeds of 60 m.p.h., and at temperatures up to 100 deg. C. Results have confirmed conventional theory, but hydrodynamic conditions (complete-film lubrication) were found to exist more frequently than was expected. The main action of e.p. lubricants appears to be to provide surface protection when there is no hydrodynamic lubrication—for example, when starting and stopping—and in general, to maintain a surface conducive to hydrodynamic lubrication.

Measurement provides the basis of the Laboratory's researches, and it is often necessary to develop new instruments and techniques to obtain the required accuracy. Many of these develop-

ments will find application in other laboratories and some are also applicable to industry. They range from portable equipment for measuring the flow of water in penstocks of hydro-electric power stations, to instruments for measuring the air content in oil samples from oil-hydraulic circuits and digital methods of measuring shaft speed, temperature and pressure. A technique for measuring the wear in diesel engine cylinder liners has also been developed, which is safe and easy to apply.

One of the most important services offered by the N.E.L. to industry is the provision of facilities for sponsored research. This service is being used with increasing frequency, and the work includes long-term basic investigations, design studies, development projects and the calibration of instruments. The N.E.L. has unique facilities to offer, and is particularly interested in proposals for novel investigations that are likely to lead to important new developments. Assistance can be provided in many ways—from accepting the full burden of the work to be undertaken, to supervising or assisting a firm's own engineers and scientists. Charges depend on the duration and complexity of the work, and in some instances it is possible to make the results completely confidential to the sponsor.

## The Advantages of Vibratory Finishing

(Continued from page 651)

of 30 min. In another instance, camshafts are being treated for removal of burrs and improvement of surface finish. The fixture employed holds 39 shafts, and the cycle time is only 12 min.

Apart from machined parts of both ferrous and non-ferrous metals, the vibratory process is being employed for operations on castings, forgings, and pressings, and it seems evident that it represents a valuable addition to available finishing methods.

## Books Received

KINEMATICS AND DYNAMICS OF MACHINERY. By R. L. Maxwell. Prentice-Hall International Inc., 28 Welbeck Street, London, W.1. 477 pp. [Price 45s. net.]

The author has covered those parts of applied Newtonian mechanics which are essential to engineers. His treatment is both graphical and analytical, and an attempt has been made to relate mathematical theory to mechanical practice. Conventional notation has not always been followed, but deviations—mainly for visual convenience—have been fully explained. The 23 chapters cover displacement, velocity and acceleration, kinetic analysis, the dynamics of particles and rigid bodies, work, energy and impulse; also—with reference to mechanisms and functional pairs—such matters as critical speeds, balancing, gyroscopic effects, cams, gearing, flywheels, and governors.

## Visit of the British Ambassador to the 7th European Machine Tool Exhibition, Brussels

DURING THE COURSE OF THE 7th European Machine Tool Exhibition, Brussels, which closed on September 12, a tour of a number of the stands of British exhibitors was made by the British Ambassador, Sir John Nicholson, K.C.M.G. His Excellency visited as many stands as possible in the time at his disposal, and the remainder were called upon by the Counsellor-Commercial. During his tour, of which some photographs are shown on this, and the following page, His Excellency was accompanied by Mr. Robert W. Asquith, chairman of Asquith Machine Tool Corporation, Ltd., and the first British President of the European Committee for the Co-operation of Machine Tool Industries.

In his Presidential address, at the official opening of the Exhibition, Mr. Asquith expressed the hope that "our user friends would take this further opportunity of discussing the improved production

facilities displayed," and that such discussions, supported by the technical demonstrations, would persuade them "that there really is something to be said for plant replacement." Most users, he continued, always seemed to have had two main lines of thought—namely, that in good times the machine tool industry reputedly could not meet demands, because of the length of its order books, and in bad times that users could not justify replacement of machines and equipment.

Continuing, Mr. Asquith said that such an outlook was unsatisfactory and that in good times the additional productivity which the newer machines could provide was greatly needed. He suggested that the users of machine tools could improve deliveries by "starting forward planning at an earlier date," and that "bad times are the best in

*(Continued on page 700)*



(Left to right) Mr. Robert W. Asquith, His Excellency the British Ambassador, Sir John Nicholson, K.C.M.G., and Mr. W. G. Hunt (William Asquith, Ltd.)



(Left to right) Mr. R. Beechey and Mr. K. G. Walton (Brooke Tool Automation, Ltd.), His Excellency, and Mr. H. S. Holden (Brooke Tool Automation, Ltd.)



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(Left to right) His Excellency and Mr. T. N. Woof, M.C. (B.S.A. Tools, Ltd.)



(Left to right) Mr. E. W. Field, O.B.E. (H. W. Ward & Co., Ltd.) and His Excellency



(Left to right) His Excellency and Mr. B. C. Harrison (Alfred Herbert, Ltd.)



(Left to right) His Excellency and Mr. H. Wilkins (Wilkins & Mitchell, Ltd.)

(Continued from page 698)  
which to undertake shop evaluation and improvement."

The President had earlier drawn attention to the co-operation which had been achieved between the European and United Kingdom industries, and expressed the hope that this pattern might be followed "by those whose work lies in a higher—or at least a different—plane, namely that of political activity." "There can be no doubt," he continued, "that there is no strength in a divided house, and since strength—and productive strength—is the real need in Western Europe to-day, there can be but one answer to the problem which the European Community is overcoming, and which has caused my own country so much heart searching."

## Industrial Notes

**BLACK & DECKER, LTD.**, Harmondsworth, Middlesex, have acquired the Italian firm of Star, manufacturers of portable electric power tools. Located at Civate, near Lake Como, the Star plant has an area of 86,000 sq. ft. The company produces a range of double-insulated tools, including single- and 2-speed drills, tappers, screwdrivers, Sanders and grinders.

**EMPLOYMENT IN THE MANUFACTURING INDUSTRIES.**—The number of persons employed in July was little changed. There was a rise of 1,000 in "engineering and electrical goods" and for "shipbuilding and marine engineering" the total was unchanged. In "metal manufacture" the total fell by 2,000, and in "vehicles" and "metal goods" by 1,000.

**THE GAUGE AND TOOL MAKERS' ASSOCIATION**, Standbrook House, 2-5 Old Bond Street, London, W.1, will hold their next Trade Luncheon on October 3 at the Savoy Hotel, London. The Guest of Honour will be the Rt. Hon. Edward Heath, M.B.E., M.P., the Lord Privy Seal, and the subject of his address will be the European Common Market.

"ALL IN A DAY'S WORK" is the title of the latest 16-mm. sound film to be released by Brook Motors, Ltd., Empress Works, Huddersfield. The film, made by the firm's production unit, is in colour and runs for 17 min. It shows many interesting manufacturing sequences in the large-quantity production of large and small electric motors, and is available on loan, free of charge.

**FERRANTI, LTD.**, Hollinwood, Lancs., are to build four 570 MVA, 3-phase, 22/430 kV delta star connected, 50 cycles per sec. double-wound generator transformers, for the Central Electricity Board. These units, which will be installed at the coal-fired power station at West Burton, Notts., will connect four 500 MW turbo-generators to the Supergrid. Claimed to be the largest generator transformers yet built, they will cost more than £1 million.

**FRASER & BORTHWICK, LTD.**, Pitt Street, Glasgow, makers of sheet metal and plastics components, and elec-

trical control panels have established a new factory at Galston, Ayrshire, with a floor area of 40,000 sq. ft. The new plant is intended to operate in conjunction with the new Colvilles steel strip mill and motor car works in Scotland. A labour force of 100 is expected to be in operation by the end of the year.

**THE PLESSEY CO., LTD.**, Ilford, Essex, inform us that they have now acquired the share capital of the SPE Co., Ltd., Slough, Bucks., from the Booker Group. The SPE Co., Ltd., manufacture a range of aircraft fuel pumps and associated equipment which is complementary to the range made by the Aircraft Mechanical Division of the Plessey Co., and will continue to operate as an autonomous company within the Plessey Group.

**MATCHLESS MACHINES, LTD.**, inform us that they have transferred their offices, stores and demonstration rooms to Matchless Works, Crawley Road, Horsham, Sussex (telephone Horsham 60271; telegraphic address, Matchless Telex Horsham; Telex No. 8798). Greatly improved showrooms are available at the new address, and the company will be able to demonstrate a far wider range of machines and equipment, under conditions as near to "normal working" as possible.

**STANDARD FOR INTERNAL COMBUSTION ENGINES.**—A revised British Standard (B.S. 765: 1961) has been issued for internal combustion engines of the spark ignition type. When the specification was first issued, in 1938, it was confined to carburettor type engines. In view of the fact that the carburettor is now sometimes replaced by fuel injection, the title and scope of the Standard have been changed. Copies can be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1 (Price 6s.—postage extra to non-subscribers).

**LAPOINTE MACHINE TOOL CO., LTD.**, Otterspool, Watford By-Pass, Watford Herts., has now completed extensions, which will add 10,000 sq. ft. to the total factory area. The extensions have been made necessary by increasing commitments in the United Kingdom and the steady expansion of export business, but provision has also been made for future growth. The extra space has permitted the expansion of storage facilities, the provision of a larger and improved re-grind section, a new apprentices training division, and a two-fold increase in the size of the electrical assembly department and machine assembly bays.

## Post-graduate Courses in Nottingham

A number of special post-graduate courses have been arranged for the Autumn term by the Nottingham and District Technical College, Burton Street, Nottingham. The subjects covered are as follows:—Pumps and compressors; electronics for mechanical engineers; applied elasticity; the statistical control of quality in engineering production, and advanced engineering metrology. The lectures will be held from 6.45 to 9.0 p.m. on Mondays to Fridays respectively, and the first lecture of each course will be in the week commencing September 25. Full details and enrolment forms can be obtained from the Registrar at the college.

## Personal

MR. GERARD YOUNG, J.P., chairman of Tempered Group, Ltd., has been elected the 326th Master Cutler.

The following new appointments have been announced:—

MR. C. R. MEYER, previously assistant managing director, to be managing director of Cincinnati Milling Machines, Ltd., Kingsbury Road, Birmingham, 24, on the resignation of Mr. J. A. BEEBE, who is returning to the U.S.A.

MR. ROBERT BUTLER, formerly a director of Quasi-Arc Ltd., as managing director of Eutectic Welding Alloys Co., Ltd., North Feltham Trading Estate, Faggs Road, Feltham, Middlesex.

MR. D. F. KEMP as technical representative of Headland Gauges, Ltd., 45-46 Lower Marsh, London, S.E.1, with responsibility for Berkshire, Buckinghamshire, Bedfordshire, Essex, Hertfordshire, Northamptonshire, Norfolk, Suffolk and the North London postal area.

MR. T. H. R. PERKINS, marketing director, as assistant managing director, Mr. D. F. W. McNAIR as deputy director of marketing, Mr. J. M. COLLINS, a director of Perkins Engines, Ltd. as general manager of the sales division and Mr. H. LYMATH as group project co-ordinator, of the Perkins Group, Peterborough.

## Scrap Metals

**MIDLANDS.**—In general, there has been no improvement in the demand for steel scrap from local steelworks, and with consumers in other parts of the country in much the same position, it is difficult for merchants to clear even their normal intake of heavy loose scrap, and bales. Local works are on rigid allocations for heavy steel scrap to specifications No. 1 and 2, and, consequently, merchants have reduced their prices for material which has to be held in stock.

Buyers of short heavy steel scrap are also keeping their acceptances to a minimum, and, at the same time, reducing their prices by about 10s. per ton. Both steel turnings and destructor bales are hard to place, as the allocations given by the blast furnaces only cover part of the output from Midlands factories and yards.

The demand for cast iron scrap continues to be keen. Where reasonable tonnages of light cast scrap can be offered, foundries are prepared to pay increased prices to ensure continuity of deliveries. During the past few weeks, the movement of machinery cast has caused an improvement of several shillings per ton in the prices for oversize cast scrap for breaking and merchants are fully occupied in dismantling plant units to provide more cast iron scrap of this type.

Light pressing scrap can be delivered by road, in particular light steel and light iron grades, but markets for No. 4 bales are limited and markets for No. 5 bales are almost entirely closed. Nickel steel scrap can be placed, prices being based on the nickel content, but there has been an easing in prices paid for stainless steel scrap.

Indications are that the present limited trading conditions will continue.

## MACHINERY'S ENQUIRY BUREAU

For many years MACHINERY has provided an enquiry service not only for subscribers and advertisers but for all engineers in need of such information as the names of makers—or their agents—of machines or equipment for performing particular operations, suppliers of various classes of material, firms with facilities for undertaking certain types of work, owners of trade names, and agents for foreign machine builders. If you have such a problem write (MACHINERY, Enquiry Bureau, Clifton House, 83-117 Euston Road, London, N.W.1) or telephone (Euston 8441, 2 lines). This service is, of course, entirely free.

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# BRITISH MACHINE TOOL Exports of New Machine Tools

Countries	Bar and Chucking Automatics		Vertical Boring Machines		Other Boring Machines		Drilling Machines		Gear-cutting Machines		Grinding, Lapping and Honing Machines		Capstan and Turret Lathes		Other Lathes	
	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £
<i>Commonwealth</i>																
South Africa .....	—	—	6 (2)	354	231 (3)	8,072	252 (95)	6,787	—	—	220 (91)	12,509	196 (4)	8,088	438 (17)	11,639
India .....	241 (2)	13,394	1,288 (4)	66,945	176 (18)	8,730	370 (13)	27,472	—	—	874 (35)	39,054	697 (15)	32,923	1,559 (17)	95,719
Pakistan .....	25 (1)	3,115	2 (1)	65	11 (3)	737	153 (3)	3,814	—	—	95 (19)	4,072	—	—	—	—
Australia .....	31 (1)	4,449	—	—	746 (6)	23,063	763 (33)	19,450	59 (3)	4,067	510 (20)	22,476	817 (19)	34,814	2,057 (55)	96,737
New Zealand .....	—	—	—	—	—	—	194 (6)	4,991	—	—	51 (4)	1,528	109 (4)	4,678	604 (20)	26,481
Canada .....	—	—	—	—	—	—	161 (6)	2,741	—	—	305 (69)	11,795	31 (1)	1,696	946 (35)	35,927
Miscellaneous .....	—	—	7 (3)	744	24 (3)	603	332 (82)	9,286	—	—	331 (82)	8,230	365 (6)	18,361	921 (57)	31,066
<i>Foreign</i>																
Soviet Union .....	200 (2)	16,362	—	—	—	—	—	—	313 (3)	15,158	1,600 (6)	56,531	—	—	293 (1)	17,088
Sweden .....	—	—	—	—	76 (1)	69 (3)	2,312	—	—	—	153 (5)	5,056	745 (17)	38,011	209 (3)	11,098
Norway .....	—	—	—	—	—	162 (2)	3,070	38 (1)	3,996	—	—	—	—	—	82 (6)	3,076
Denmark .....	—	—	—	—	—	35 (4)	1,508	—	—	—	—	—	65 (2)	3,772	25 (2)	1,283
Western Germany .....	—	—	33 (1)	1,028	140 (3)	12,713	136 (2)	—	—	—	229 (5)	19,637	140 (3)	6,699	541 (35)	21,865
Netherlands .....	—	—	—	—	2 (1)	314	115 (6)	3,240	—	—	77 (3)	4,964	236 (8)	14,802	17 (2)	714
Belgium .....	—	—	—	—	6 (9)	265	36 (4)	1,349	—	—	115 (5)	3,894	283 (6)	7,597	—	—
France .....	39 (1)	2,199	159 (1)	4,337	8 (1)	175	—	—	—	—	234 (6)	11,655	248 (4)	12,356	274 (4)	12,187
Switzerland .....	—	—	—	—	—	—	36 (3)	1,538	—	—	110 (5)	8,046	219 (5)	14,662	259 (12)	22,262
Spain .....	—	—	—	—	—	—	—	—	—	—	440 (5)	25,151	—	—	—	—
Italy .....	363 (2)	23,263	—	—	—	—	16 (1)	519	165 (4)	4,766	395 (21)	18,758	525 (5)	30,360	655 (3)	46,801
U.S. America .....	—	—	—	—	—	—	74 (8)	1,678	—	—	117 (9)	7,690	99 (7)	5,181	516 (25)	18,205
Miscellaneous .....	40 (1)	5,122	292 (3)	8,367	351 (9)	25,700	344 (79)	10,134	132 (3)	7,560	951 (134)	48,894	513 (15)	27,077	1,357 (75)	60,156
<b>Total</b> .....	<b>939 (10)</b>	<b>67,904</b>	<b>1,787 (15)</b>	<b>81,850</b>	<b>1,695 (57)</b>	<b>80,448</b>	<b>3,113 (356)</b>	<b>100,025</b>	<b>707 (14)</b>	<b>35,547</b>	<b>6,807 (526)</b>	<b>309,940</b>	<b>5,288 (123)</b>	<b>261,077</b>	<b>10,753 (381)</b>	<b>502,304</b>

Total exports of reconditioned machine tools: Quantity: No. 212; Weight, 17,449 cwt.; Value, £88,806.

Total exports of imported machine tools: Quantity: Weight, 1,274 cwt.; Value, £44,216.

# Imports of New Machine Tools

Country of Origin	Bar and Chucking Automatics		Vertical Boring Machines		Other Boring Machines		Drilling Machines		Gear-cutting Machines		Grinding, Lapping and Honing Machines		Capstan and Turret Lathes		Other Lathes	
	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £	Quantity, Cwt. and No.	Value £
Sweden .....	—	—	—	—	10 (1)	1,121	199 (27)	4,449	—	—	795 (22)	53,417	—	—	32 (3)	755
Western Germany .....	57 (3)	6,504	587 (8)	28,622	457 (11)	27,808	248 (26)	11,420	143 (4)	12,033	2,097 (42)	140,102	359 (11)	32,303	1,159 (50)	65,612
France .....	—	—	—	—	—	—	—	—	—	—	—	—	—	487 (1)	61 (2)	4,006
Switzerland .....	362 (22)	38,577	548 (3)	41,074	—	—	44 (5)	2,671	75 (7)	9,157	340 (59)	37,342	308 (7)	30,142	480 (15)	39,527
U.S. America .....	289 (3)	15,436	14 (2)	1,300	142 (3)	16,933	363 (14)	32,514	1,047 (48)	93,567	3,304 (148)	250,360	—	—	591 (9)	34,611
Miscellaneous .....	—	—	81 (2)	4,261	1,624 (3)	99,912	140 (4)	2,581	532 (5)	25,168	366 (22)	15,049	133 (3)	2,173	993 (12)	33,049
<b>Total</b> .....	<b>708 (28)</b>	<b>60,517</b>	<b>1,230 (15)</b>	<b>75,257</b>	<b>2,233 (18)</b>	<b>145,774</b>	<b>994 (76)</b>	<b>53,635</b>	<b>1,797 (30)</b>	<b>139,925</b>	<b>6,902 (193)</b>	<b>496,270</b>	<b>810 (22)</b>	<b>65,105</b>	<b>3,316 (91)</b>	<b>177,560</b>

Total imports of reconditioned machine tools:—Quantity: No. 134; Weight, 1,975 cwt.; Value, £72,875.



TOOL  
e Tools**IMPORTS AND EXPORTS (Classified)**  
and Parts during April, 1961

Value £	Milling Machines		Presses		Sheet-metal Working Machines		Sawing Machines		Screwing and Threading Machines		Planing, Shaping and Slotting Machines		Unit Transfer Machines and Heads		Other Machines		Machine Tool Parts*		Total	
	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £
11,639	152 (6)	8,257	1,657 (18)	30,855	551 (10)	8,150	35 (4)	746	28 (1)	811	42 (3)	1,041	66 (6)	3,522	913 (52)	25,550	257	12,718	5,044 (312)	139,109
95,719	569 (10)	32,370	439 (5)	10,912	598 (6)	17,090	268 (4)	21,054	—	—	372 (6)	12,768	—	—	251 (25)	13,839	1,467	80,017	9,169 (160)	472,287
—	189 (2)	9,687	—	—	164 (2)	4,760	23 (1)	1,194	—	—	108 (1)	2,756	—	—	7 (4)	581	131	2,433	908 (37)	33,214
96,737	730 (24)	32,409	568 (6)	18,489	77 (40)	1,972	—	—	285 (9)	18,545	143 (13)	4,691	—	—	13 (3)	1,149	1,077	51,360	7,876 (232)	333,671
26,481	192 (5)	7,362	277 (8)	4,222	20 (2)	824	11 (2)	413	—	—	65 (4)	2,043	—	—	110 (14)	3,283	40	3,939	1,673 (77)	59,764
35,927	423 (7)	21,389	—	—	127 (1)	2,152	3 (2)	146	31 (1)	2,902	51 (5)	1,161	—	—	225 (4)	5,143	101	8,162	2,404 (131)	93,214
31,066	102 (4)	4,629	6 (7)	138	299 (25)	8,021	51 (7)	1,581	25 (4)	850	64 (5)	1,470	—	—	72 (28)	3,606	348	19,025	2,947 (313)	107,610
17,088	—	—	—	—	94 (2)	13,463	—	—	450 (3)	22,601	—	—	—	—	537 (1)	16,200	—	—	3,487 (18)	157,403
11,098	481 (4)	21,696	—	—	—	—	15 (7)	1,475	—	—	15 (1)	900	—	—	371 (6)	15,618	99	8,244	2,157 (45)	104,486
3,076	—	—	210 (2)	3,718	—	11	—	—	—	—	29 (1)	549	—	—	4 (1)	307	14	1,802	541 (14)	16,529
1,283	125 (2)	6,081	—	—	—	—	—	—	7 (1)	368	63 (2)	—	—	—	138 (2)	6,333	20	2,194	415 (13)	21,539
21,865	188 (2)	12,303	169 (2)	8,911	60 (1)	2,250	—	—	—	—	5,639	—	—	—	189 (3)	7,477	272	24,151	2,025 (59)	122,809
714	365 (6)	14,493	107 (1)	5,501	11 (6)	550	42 (4)	734	105 (4)	7,531	—	—	—	—	566 (6)	33,992	238	20,880	1,881 (47)	107,715
—	—	—	—	—	260 (2)	9,223	84 (1)	1,652	—	—	27 (10)	754	—	—	6 (6)	330	84	3,910	901 (43)	28,974
12,187	140 (1)	4,855	510 (44)	13,458	57 (1)	6,020	136 (1)	2,522	85 (1)	5,823	—	—	—	—	30 (2)	929	414	30,639	2,334 (68)	107,155
12,262	705 (8)	30,149	31 (1)	2,475	—	—	—	—	—	—	—	—	—	—	35 (1)	1,375	25	2,869	1,420 (48)	73,376
—	—	—	170 (1)	6,952	—	—	—	—	—	—	—	—	—	—	85 (3)	9,175	8	1,281	703 (9)	42,559
46,801	—	—	1,985 (3)	44,933	225 (5)	17,629	—	—	46 (2)	5,539	61 (2)	4,023	—	—	8 (2)	391	241	17,212	4,685 (50)	214,194
18,205	34 (1)	1,292	12 (1)	336	—	—	—	—	165 (2)	9,749	—	—	—	—	237 (10)	11,887	211	11,512	1,465 (63)	67,530
60,156	831 (13)	45,885	86 (34)	17,606	720 (14)	17,293	21 (14)	691	60 (2)	6,080	1,364 (9)	24,154	19 (1)	1,725	1,895 (44)	81,340	1,213	38,834	10,964 (450)	426,618
502,304	5,226 (95)	252,857	7,002 (133)	168,506	3,263 (118)	109,408	689 (47)	32,208	1,350 (32)	86,438	2,341 (60)	56,310	85 (7)	5,247	5,694 (215)	238,505	6,260	341,182	62,999 (2189)	2,729,756

Figures in parentheses denote number of machines.

\* Not including machine tool cutting parts.

e Tools

**Imports and Parts during April, 1961**

Value £	Milling Machines		Presses		Sheet-metal Working Machines		Sawing Machines		Screwing and Threading Machines		Planing, Shaping and Slotting Machines		Unit Transfer Machines and Heads		Other Machines		Machine Tool Parts*		Total	
	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £	Quantity. Cwt. and No.	Value £
755	191 (2)	8,992	95 (6)	5,647	215 (8)	5,934	—	—	—	—	—	—	—	—	285 (2)	19,809	51	6,504	1,873 (71)	106,628
65,612	808 (16)	57,390	3,061 (34)	90,769	688 (67)	32,612	504 (48)	17,268	88 (17)	6,999	421 (7)	19,344	—	—	1,084 (31)	69,345	526	47,283	12,307 (375)	665,414
4,006	374 (6)	20,979	191 (11)	6,547	132 (7)	7,955	—	—	569 (3)	33,796	—	—	—	—	2,036 (39)	64,336	540	24,532	3,913 (69)	162,638
39,527	464 (17)	33,415	96 (4)	9,975	231 (4)	6,541	5 (1)	293	5 (2)	526	—	—	—	—	909 (9)	19,654	108	28,283	3,975 (155)	297,177
34,611	1,209 (26)	62,740	2,467 (38)	73,574	582 (8)	29,858	—	—	330 (28)	13,116	2,038 (2)	44,484	3,069 (3)	338,109	1,744 (31)	177,100	1,823	209,177	19,012 (229)	1,392,879
33,049	2,255 (50)	68,964	902 (18)	17,074	324 (16)	17,957	237 (45)	6,621	63 (2)	4,980	53 (2)	7,576	—	—	724 (42)	37,825	490	24,140	8,915 (225)	367,330
177,560	5,301 (117)	252,480	6,832 (111)	203,586	2,172 (110)	100,857	746 (94)	24,182	1,055 (51)	59,417	2,512 (11)	71,404	3,069 (3)	338,109	6,782 (154)	388,069	3,538	339,919	49,997 (1,124)	2,992,066

Figures in parentheses denote number of machines.

\* Not including machine tool cutting parts.

## Trade Publications

**ELECTROMARK (G.B.), LTD.**, Harlequin Avenue, Great West Road, Brentford, Middlesex.—Leaflet describing the Electromark electrolytic marking equipments for metals, which are employed with stencils and are available in seven different types and sizes.

**INA NEEDLE BEARINGS, LTD.**, Dafen, Llanelli, Carmar. —Booklet of Technical Information, Series 14/2 (1961) concerned with "Ina Needle Bearings in Mechanical Handling Equipment and Construction Machines." This

24-page publication contains 38 sectional drawings showing bearing mounting arrangements for a variety of shafts, pulleys, chain wheels, rope pulleys, drums, and other components in this field. Useful notes on design are given for each application.

**RAPID MAGNETIC, LTD.**, Lombard Street, Birmingham, 12.—Leaflet giving details of the Andox range of permanent magnetic pulleys for the removal of tramp iron from materials carried by belt conveyors. These pulleys are available in diameters from 12 to 24 in., and with two magnetic intensities.

## Machine Tool Share Market

Business in stock markets remained at a low level during the period under review, and the general trend was for prices to drift to lower levels in nearly all sections, due to the effects of the international situation.

British Government stocks and similar gilt-edged issues held quietly steady for the most part, but finished with a slight setback in values.

Commercial and industrial share markets were subdued and mainly dull. Apart from a few firm features on selective buying, the majority of changes were easier on balance.

Among machine tool issues Edgar Allen lost 1s. 3d. at 32s. 3d.; Chas. Churchill, 3d. at 9s. 1½d.; Geo. Cohen, 3d. at 10s. 9d.; Greenwood & Batley, 1s. 6d. at 16s. 3d.; and W. E. Sykes "B," 1s. at 24s. 7½d. On the other hand, Arnott & Harrison advanced 3d. to 10s. 6d.; Coventry Gauge & Tool, 6d. to 28s. 10½d.; Craven Bros. (Manchester), 3d. to 8s. 4½d.; John Harper, 4½d. to 6s. 10½d.; Alfred Herbert, 1s. to 67s. 6d.; John Holroyd "B," 1s. 3d. to 16s. 3d.; and Samuel Osborn, 3d. to 48s.

**CLARKSON (ENGINEERS), LTD.**—Interim dividend of 7½ per cent.

COMPANY		Denom.	Middle Price	COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd. ....	Ord. ....	1/-	1/6xd	Herbert (Alfred), Ltd. ....	Ord. ....	£1	67/6
Allen (Edgar) & Co., Ltd. ....	Ord. ....	£1	32/3	Holroyd (John) & Co., Ltd. ....	"A" Ord. ....	5/-	20/-
	5% Prf. ....	£1	13/6*	" " " " " " " " " " " "	"B" Ord. ....	5/-	16/3
Arnott & Harrison, Ltd. ....	Ord. ....	4/-	10/6				
Asquith Machine Tool Corp., Ltd. ....	Ord. ....	5/-	9/-	Jones (A. A.) & Shipman, Ltd. ....	Ord. ....	5/-	25/6xd
	6% Cum. Prf. ....	£1	16/6		5% Cum. Prf. ....	5/-	4/9
Birmingham Small Arms Co., Ltd. ....	Ord. ....	10/-	21/-	Kearney & Trecker "C.V.A.", Ltd. ....	5½% Red. ....	£1	8/9
" " " " " " " " " " " "					Cum. Prf. ....		
" " " " " " " " " " " "	5% Cum. ....	£1	13/-		Prfd. Ord. ....	£1	13/9
" " " " " " " " " " " "	A" Prf. ....			Kearns (H. W.) & Co., Ltd. ....	Ord. ....	5/-	21/3
" " " " " " " " " " " "	6% Cum. ....	£1	16/-	Kerry's (Gs. Britain), Ltd. ....	Ord. ....	5/-	8/9
" " " " " " " " " " " "	B" Prf. ....			Macreadys Metal Co., Ltd. ....	Ord. ....	5/-	15/-
" " " " " " " " " " " "	4% 1st Mort. ....	Stk.	98½	Martin Bros. (Machinery), Ltd. ....	Ord. ....	2/-	2/6
	Deb. ....			Massey (B. & S.), Ltd. ....	Ord. ....	5/-	10/6
British Oxygen Co., Ltd. ....	Ord. ....	5/-	18/6				
	6% Cum. Prf. ....	£1	18/6	Newall Engineering Co., Ltd. ....	Ord. ....	2/-	7/-
Brooke Tool Manufacturing Co., Ltd. ....	Ord. ....	5/-	8/3	Newman Industries, Ltd. ....	Ord. ....	2/-	7/-
Broom & Wade, Ltd. ....	Ord. ....	5/-	26/6		6% Prf. Ord. ....	5/-	5/-
	6% Cum. Prf. ....	£1	16/6	Noble & Lund, Ltd. ....	Ord. ....	2/-	5/9
Brown (David) Corporation, Ltd. ....	5½% Cum. Prf. ....	£1	15/-	Norton, W. E. (Holdings), Ltd. ....	Ord. ....	2/-	8/-
Buck & Hickman, Ltd. ....	6% Cum. Prf. ....	£1	17/-	Osborn (Samuel) & Co., Ltd. ....	Ord. ....	5/-	48/-
Bustler Machine Tool Co., Ltd. ....	Ord. ....	5/-	15/-		5½% Cum. Prf. ....	£1	22/3
	5% Cum. Prf. ....	£1	12/6		Ord. ....	5/-	16/3
Churchill (Charles) & Co., Ltd. ....	Ord. ....	2/-	9/1½	Pratt (F.) Engineering Corporation, Ltd. ....	Ord. ....	10/-	32/6
	6% Cum. Prf. ....	£1	25/7½†	Sanderson Kayser, Ltd. ....	6½% Cum. Prf. ....	£1	16/3
Clarkson (Engrs.), Ltd. ....	Ord. ....	1/-	6/3		Ord. ....	4/-	8/6
				Scottish Machine Tool Corporation, Ltd. ....	Ord. ....	£1	56/10½
Cohen (George), 600 Group, Ltd. ....	Ord. ....	5/-	10/9xd	Shardlow (Ambrose) & Co., Ltd. ....	Ord. ....	5/-	15/1½
	4½% Cum. Prf. ....	£1	11/6xd	Shaw (John) & Sons, Wolverhampton, Ltd. ....	Ord. ....		
Coventry Gauge & Tool Co., Ltd. ....	Ord. ....	10/-	28/10½		Ord. ....	4/-	19/-
" " " " " " " " " " " "	5% Cum. Prf. ....	£1	16/3	Sheffield Twist Drill & Steel Co., Ltd. ....	5% Cum. Prf. ....	£1	13/3
	Red. Prf. ....				Ord. ....	5/-	7/6
Craven Bros. (Manchester), Ltd. ....	Ord. ....	5/-	8/4½	Stedall & Co., Ltd. ....	"B" non-voting Ord. ....	10/-	24/7½xd
Elliott (B.) & Co., Ltd. ....	Ord. ....	1/-	2/6	Sykes (W. E.), Ltd. ....	Ord. ....	5/-	15/6xd
" " " " " " " " " " " "	4½% Red. ....	£1	12/-		4½% Deb. ....	Stk.	81½
	Cum. Prf. ....				1961-1977		
Firth Brown Tools, Ltd. ....	4% Cum. Prf. ....	£1	10/-	Wadkin, Ltd. ....	Ord. ....	10/-	26/-
Greenwood & Batley, Ltd. ....	Ord. ....	10/-	16/3	Ward (Thos. W.), Ltd. ....	5% Cum. ....	£1	72/6
					1st Prf. ....	£1	13/6
Harper (John) & Co., Ltd. ....	Ord. ....	5/-	6/10½	" " " " " " " " " " " "	5% Cum. ....	£1	20/-
" " " " " " " " " " " "	4½% Red. ....	£1	10/-		2nd Prf. ....	1/-	3/-
	Cum. Prf. ....			Willson Lathes, Ltd. ....	Ord. ....		

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. \* Sheffield price. † Birmingham price.

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These Swiss built machines are designed for high class engraving and can be supplied in five different sizes :

	Model 0H Bench	Model 2L
Pantograph ratios	50 : 1 - 1 : 1	50 : 1 - 1 : 1
Cutter field at 1 : 1	4 $\frac{1}{2}$ in. x 2 $\frac{1}{2}$ in.	10 $\frac{1}{2}$ in. x 7 $\frac{1}{2}$ in.
Work table	12in. x 6 $\frac{1}{2}$ in.	19 $\frac{1}{2}$ in. x 9in.
Copy holder	15 $\frac{1}{2}$ in. x 6 $\frac{1}{2}$ in.	21 $\frac{1}{2}$ in. x 13in.



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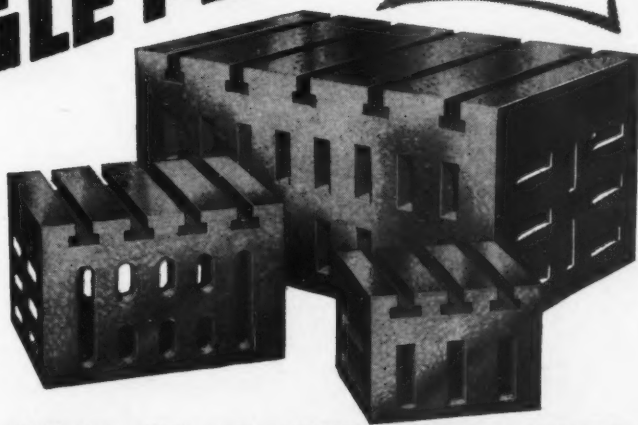


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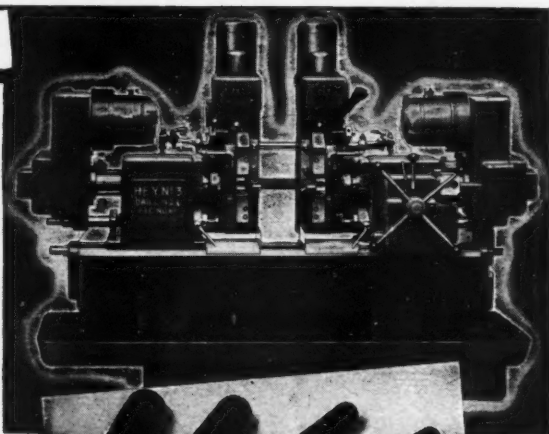
Facing  $\frac{1}{8}$ " off each end and drilling  $\frac{7}{16}$ " centres in  $2\frac{1}{2}$ " diameter Electric Motor Shafts in a floor to floor time of 27 seconds, is typical of the high production which can be achieved on the —

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- Perfect alignment of centres
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Face 5" diameter. Standard Vices for maximum bar capacity of 6 $\frac{1}{2}$ " or 8" diameter. Minimum length handled 3". Standard bed length to take work up to 24", 48", 72" or 108" long.

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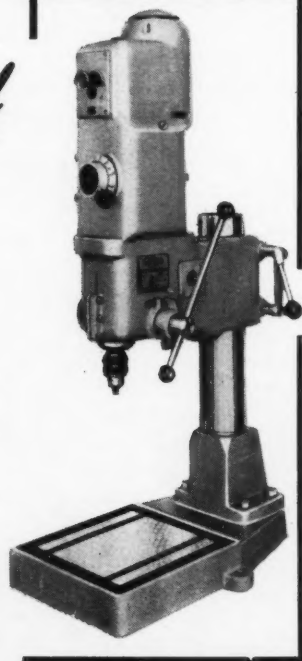
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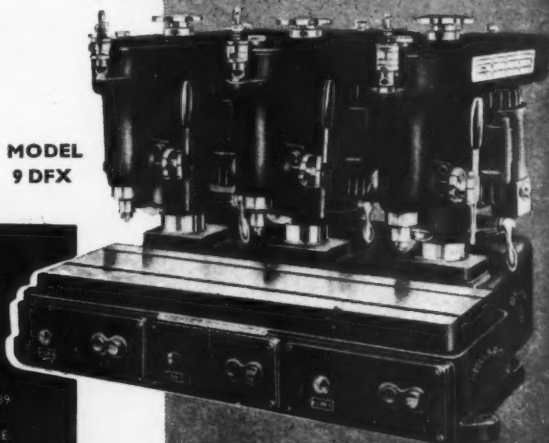
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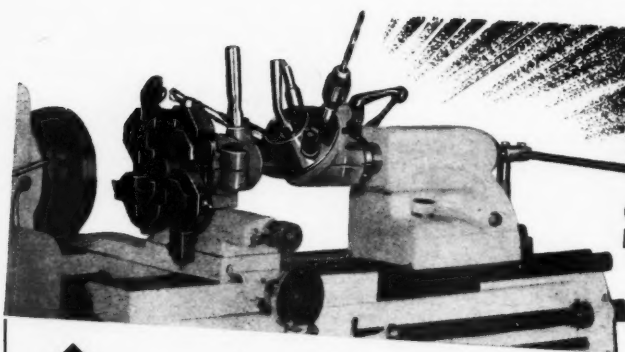


**MODEL  
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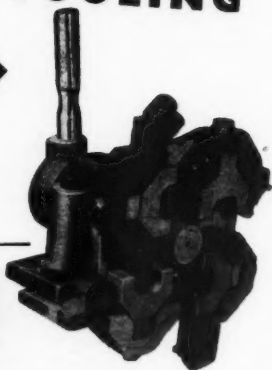
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Takes five separate tools and can be fitted in a few seconds to the tailstock spindle. Positive tool centring by indexing plunger. Rigid locking. Two sizes available.

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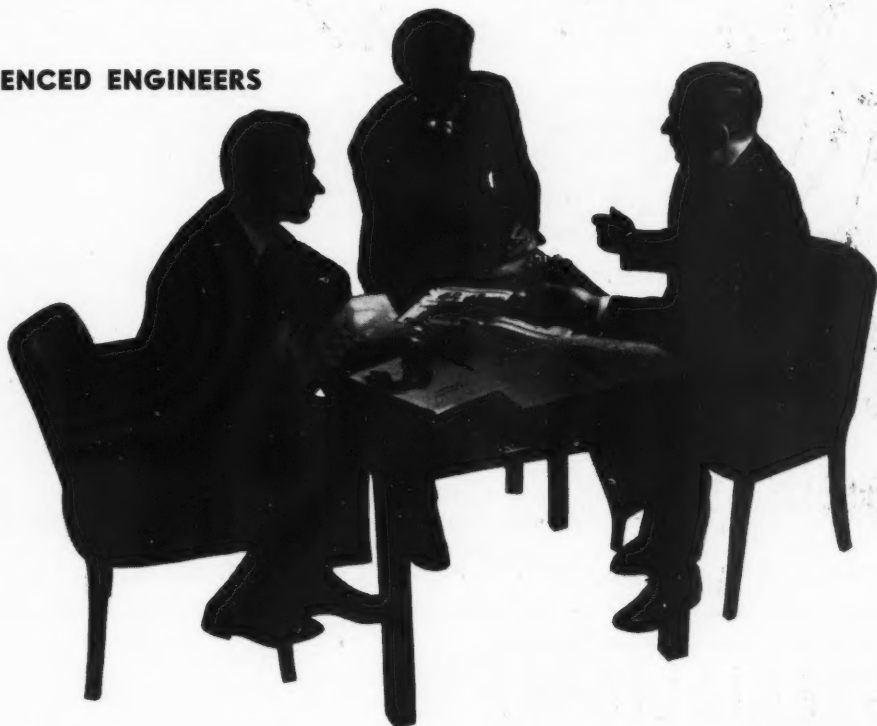
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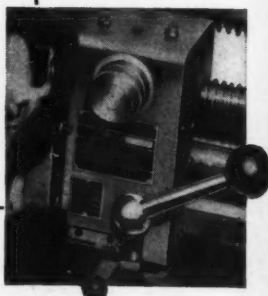


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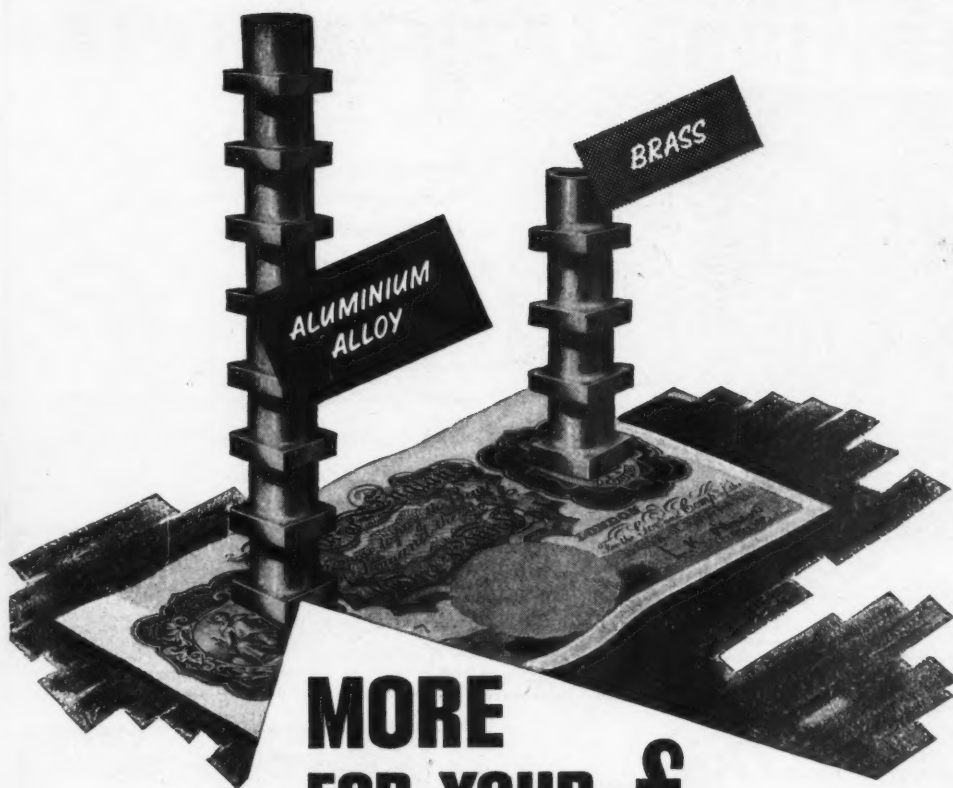
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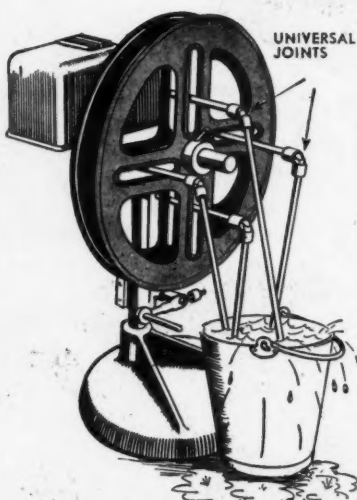
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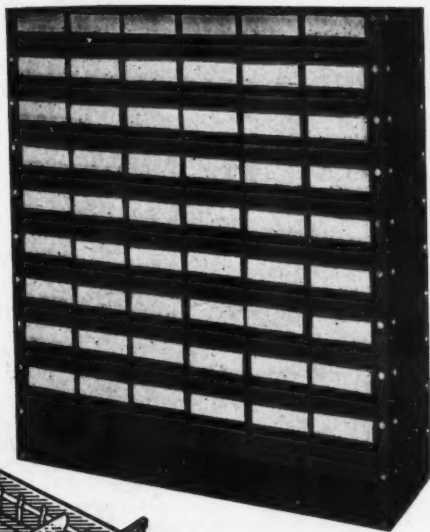
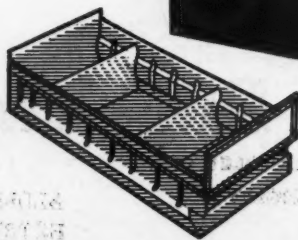
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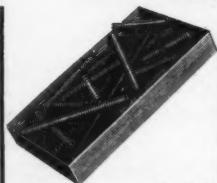


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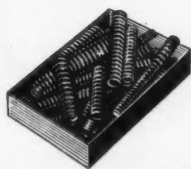
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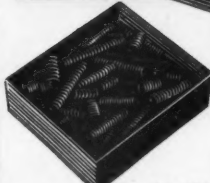
No. 1217  
One gross  
Assorted Springs  
45/-



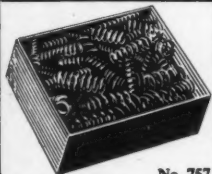
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Expansion Springs, suitable for  
carburettor control, etc. 15/-.



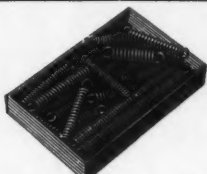
No. 760  
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Compression Springs. 1" to 4" long,  
22 to 18 S.W.G.,  $\frac{1}{8}$ " to  $\frac{1}{2}$ " diam. 7/6.



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Three dozen Assorted 1" to 4"  
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Extra Light Compression, 1  
gross Assorted,  $\frac{1}{8}$ " to  $\frac{1}{4}$ " diam.,  
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AND, of course, BSI accuracy and dimensions

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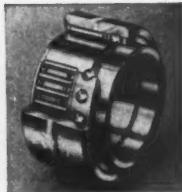
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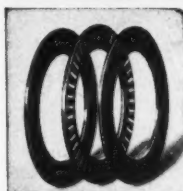


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(NKX Series)Ina Combined Bearing  
(NKIB Series)

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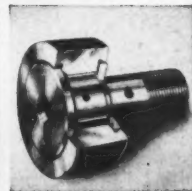
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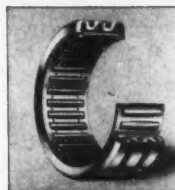
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(NATR Series)

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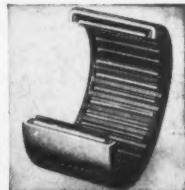
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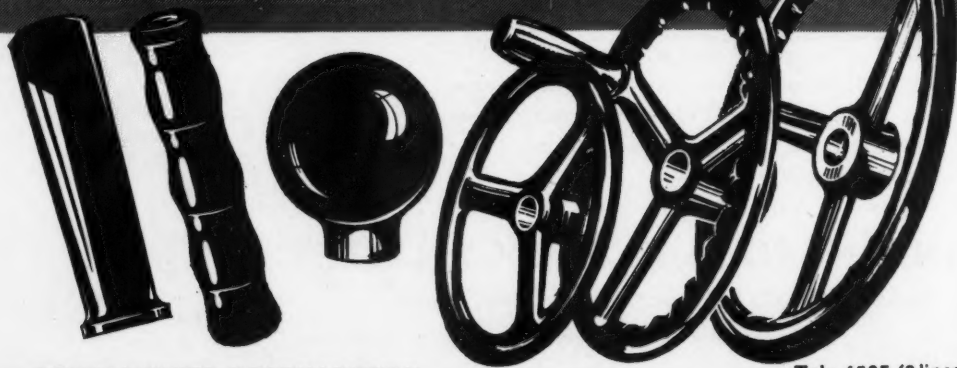


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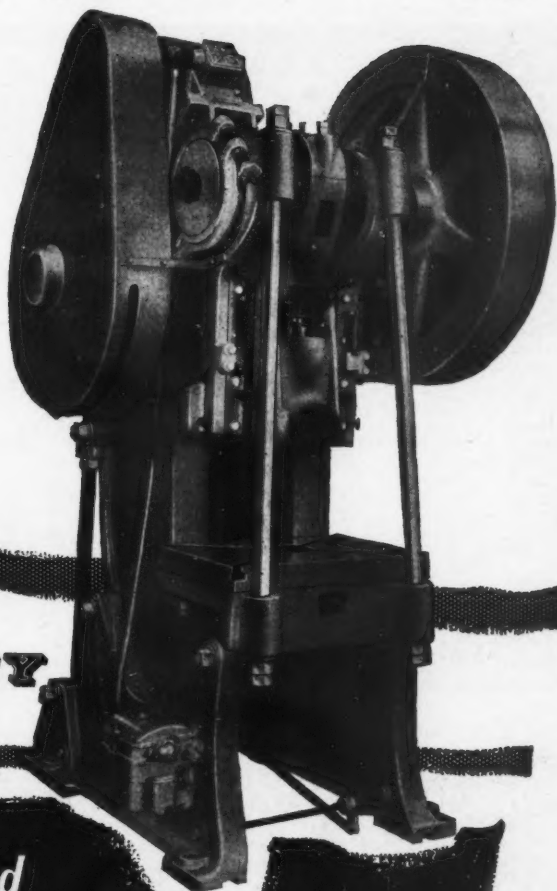
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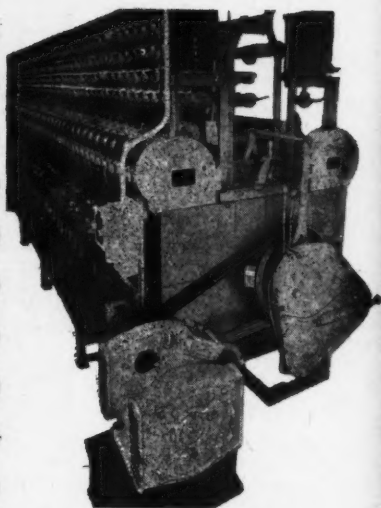
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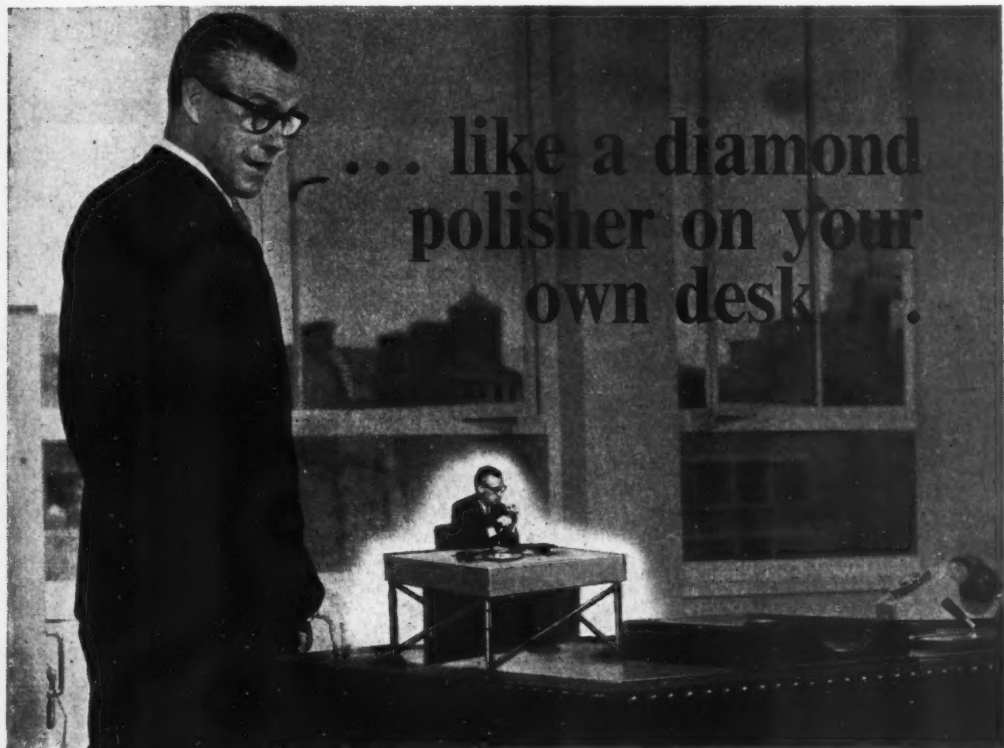
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*High Speed Power  
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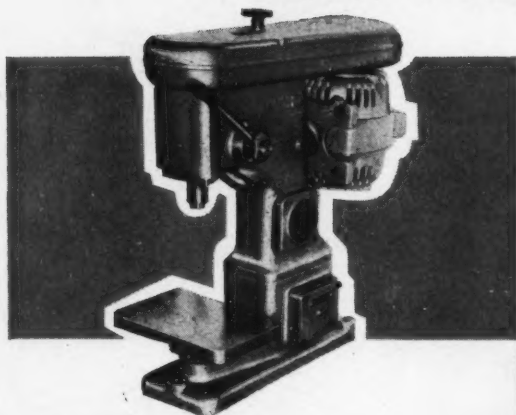
Sales Division

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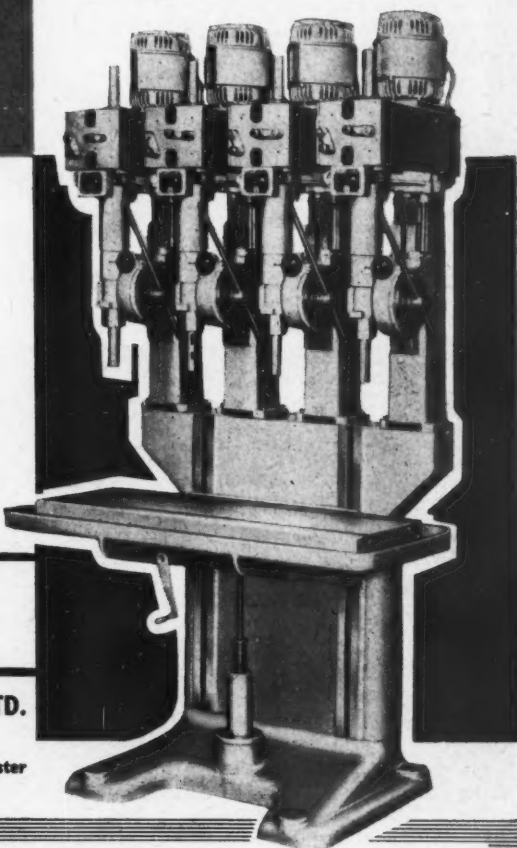
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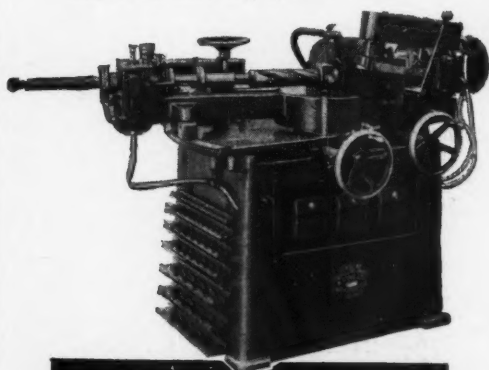


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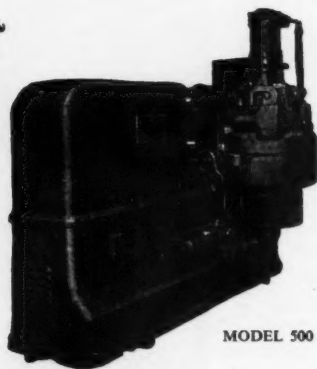
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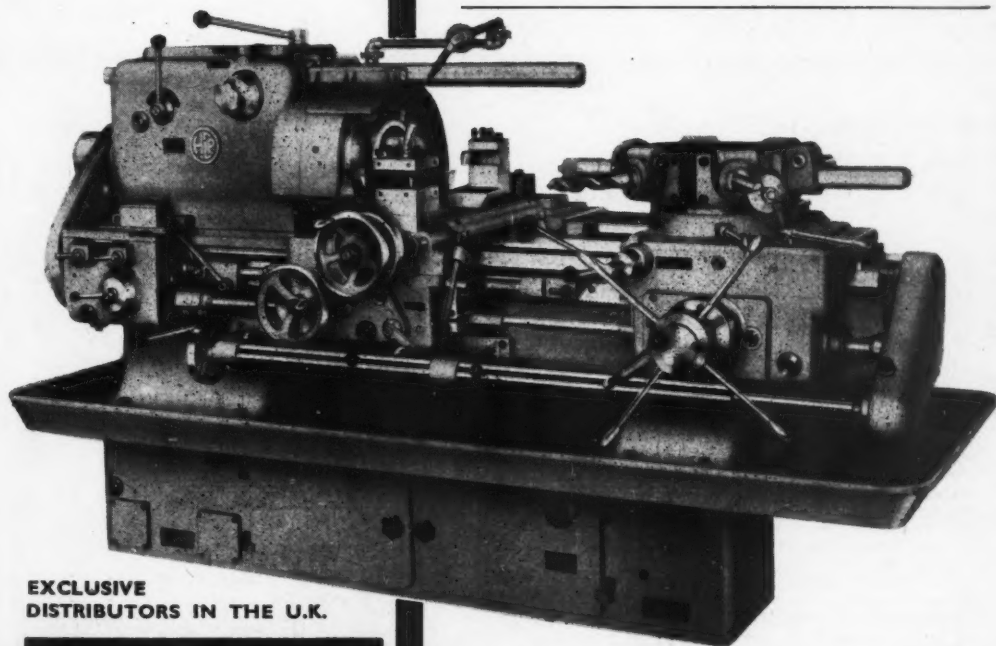
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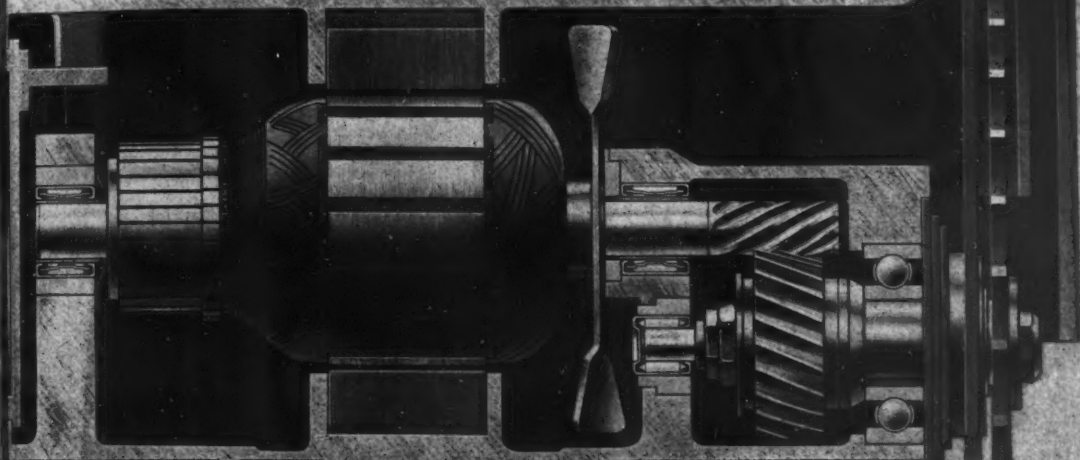
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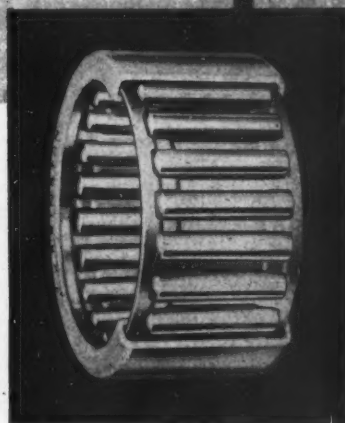
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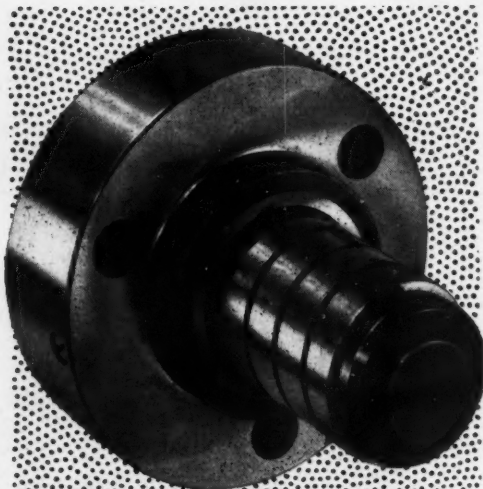
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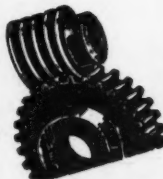
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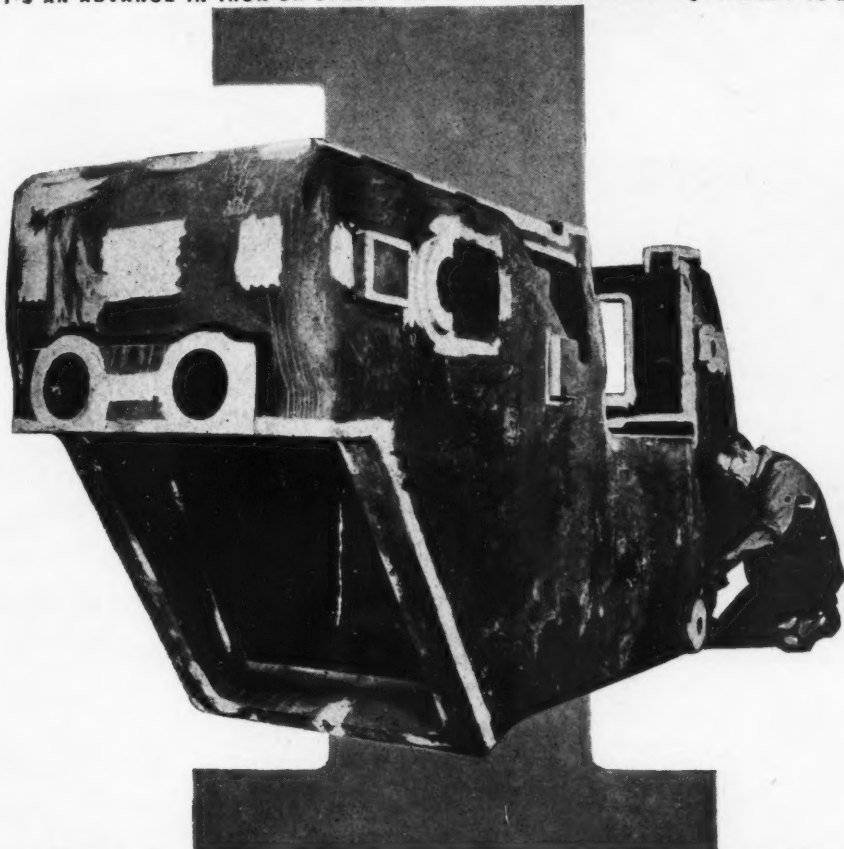


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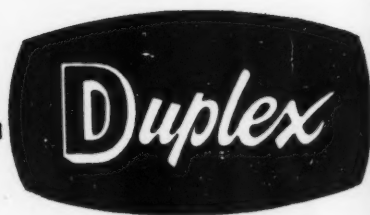
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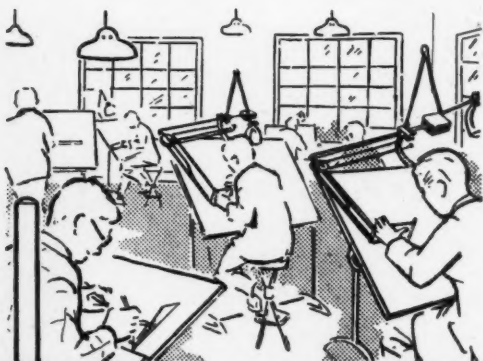
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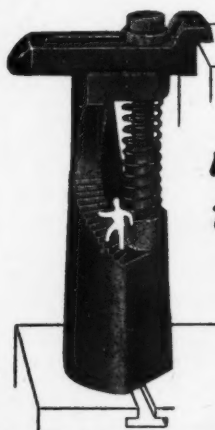
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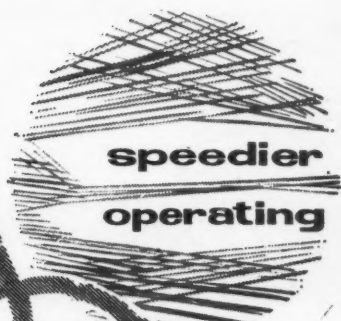
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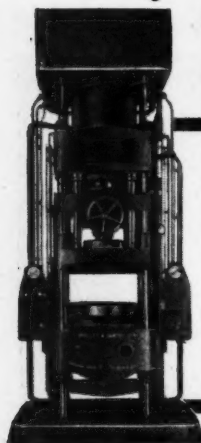
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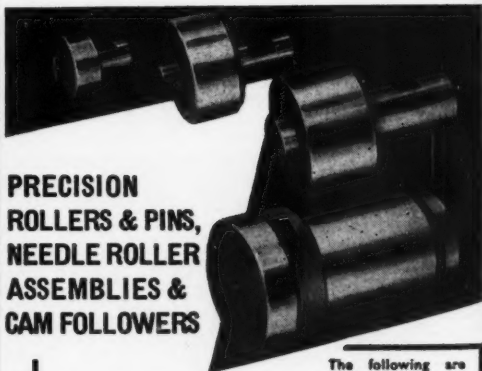
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KEYWAYS**

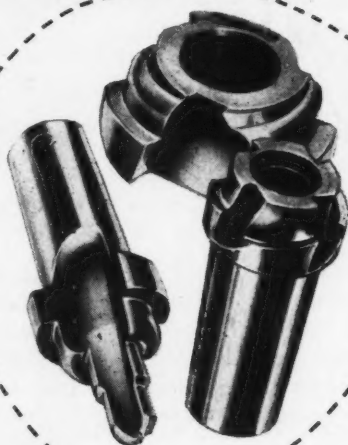
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"Cut perfect taper or parallel Keyways with any type of hand press, without skilled labour or elaborate set up. No. 0 Set for  $\frac{1}{8}$ "- $\frac{1}{2}$ " with guide diameters  $\frac{1}{8}$ "- $\frac{1}{2}$ ". No. 1 set for  $\frac{1}{4}$ "- $\frac{3}{4}$ " with guide diameters  $\frac{1}{4}$ "- $\frac{3}{4}$ ". No. 2 Set for  $\frac{3}{8}$ "- $\frac{1}{2}$ " with guide diameters  $\frac{1}{4}$ "- $\frac{1}{2}$ ". No. 3 Set for  $\frac{1}{2}$ " and  $\frac{3}{4}$ " with guide diameters  $\frac{1}{2}$ "- $\frac{3}{4}$ ". Broaches and guides are interchangeable for non-standard Keyways."

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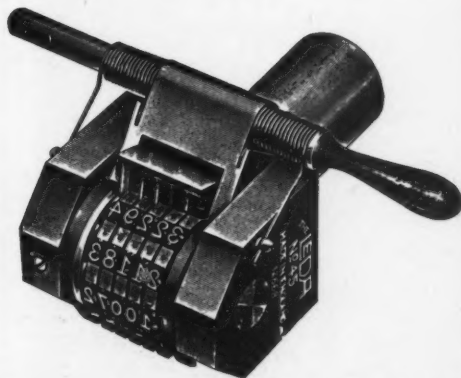
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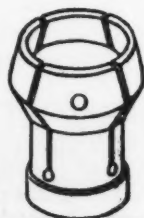
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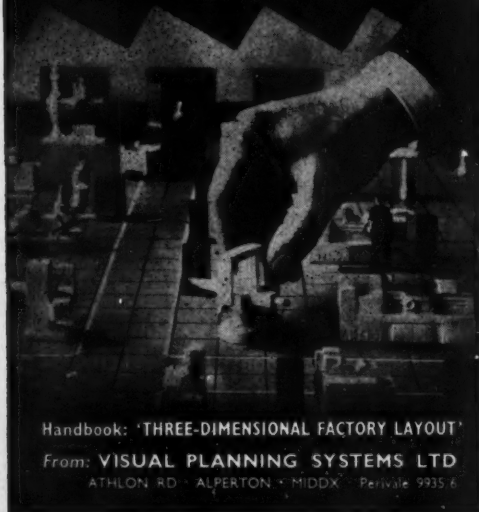


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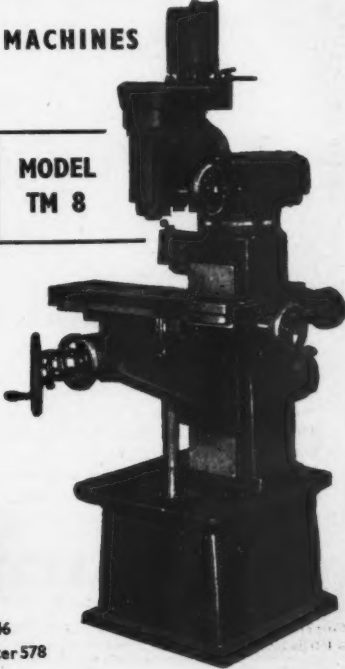
Model	Table	Table to Spindle
1	22in. by 6½in.	16in.
2	28in. by 6½in.	16in.
3	28in. by 8in.	15in.
4	28in. by 8in.	19in.
5	28in. by 10in.	19in.

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Radial and Sliding Arm, Swivelling and Down Feed Head. Power Feed to table optional.

Model	Table	Table to Spindle
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**MODEL TM 8**



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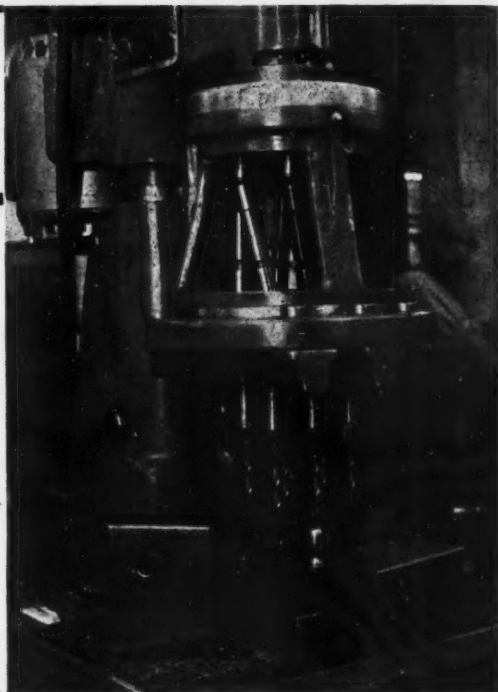
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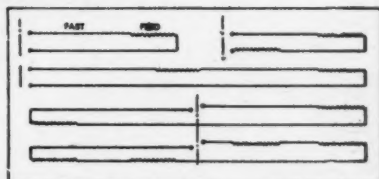
for Fast Approach and Return Speeds  
... at a very sensible price.

3 STANDARD MODELS AVAILABLE

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Travel	0"-5"	0"-6"	0" x 12"
Work Table	12" x 4½"	18" x 6½"	26" x 9½"
Approx. thrust	180 lb.	400 lb.	800 lb.

Recommended air line pressure: 70/100 lb. per sq. in.

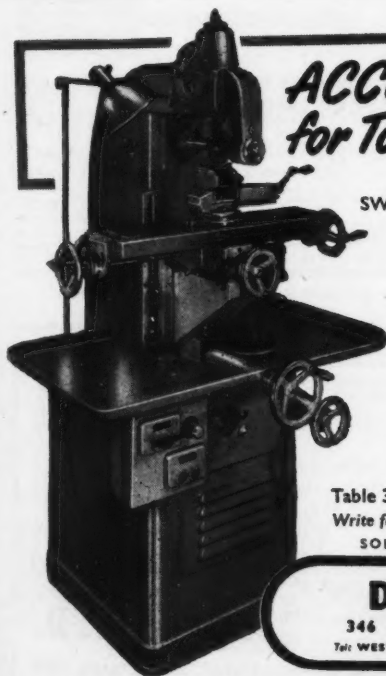
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Diagrammatic illustration showing some of the many cycles available.

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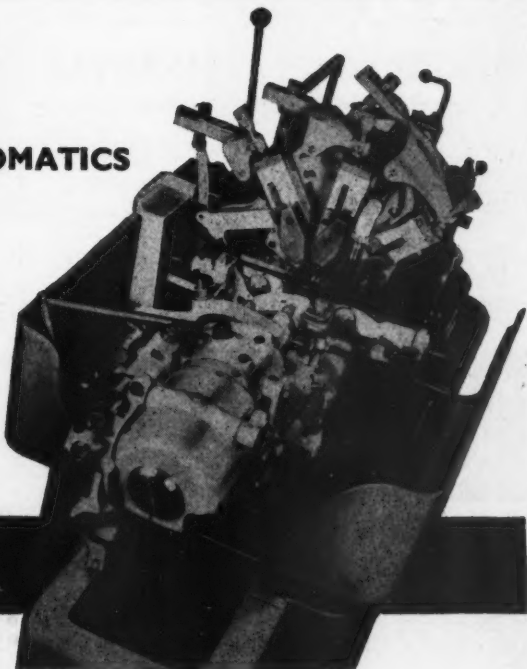
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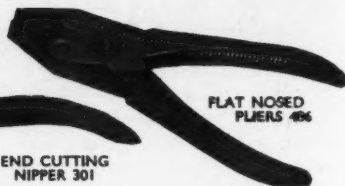
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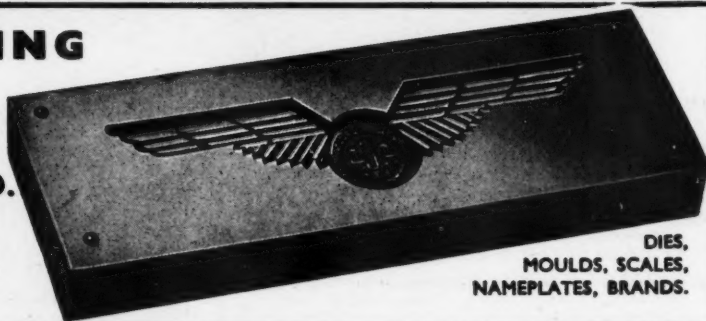
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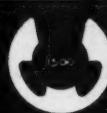
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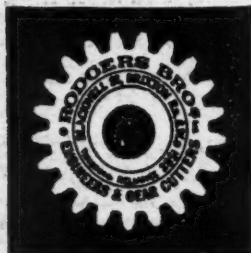
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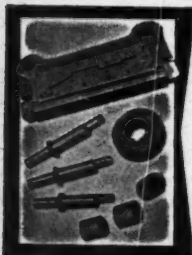
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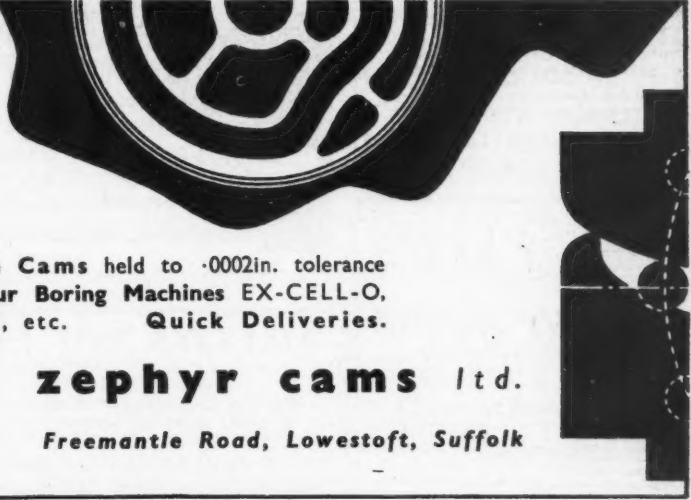
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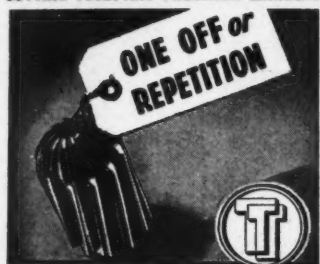
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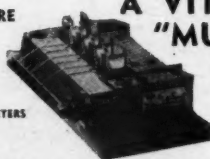
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**TOWN** 5ft. Non elevating arm Radial Drill, with box bed, 122-790 r.p.m. No. 5 Morse Taper.

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**BULLARD** Multi-Au-Matic 12in. 6 spindle.

### BORING MACHINES

**WETZEL** Horizontal traversing column Foot Boring and Facing Machine, 7in. diameter travelling spindle, 45in. diameter facing head. (Two available.)

**KEARNS** Model OB Horizontal Boring and Facing Machine, 2 1/2in. diameter travelling spindle (1957).

**UNION** Model BFT100 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle (1958).

**KEARNS** Model OC Horizontal Boring Machine, 3in. dia. travelling spindle.

**KEARNS** No. 4 Horizontal Boring and Facing Machine, 4in. diameter travelling spindle.

**WEBSTER & BENNETT** Vertical Boring Machine, table 50in. diameter.

**RICHARDS** Type PRT Horizontal Foot Boring Machine, 3 1/2in. travelling spindle, 28in. diameter facing head.

### CAPSTAN AND CENTRE LATHES

**CHURCHILL-REDMAN** Model 18NM Heavy Duty S.S. & S.C. Gap Bed Centre Lathe, 13in. centre height x 72in. between centres. Swing in gap 50in.

**MITCHELL** Model DM10 S.S. & S.C. Gap Bed Centre Lathe, 10 1/2in. centre height x 7ft. 5in. between centres. (NEW.)

**OLDFIELD & SCHOFIELD** Surfacing and Boring Lathe, 10 1/2in. centre height.

**WARD** 7B Combination Turret Lathe.

**NILES** Heavy Duty Centre Lathe, S.S. & S.C. 17in. centre height x 28ft. between centres.

**U.L.R.O.** Heavy Duty Centre Lathe, 16in. centre height x 30ft. between centres.

### DRILLING MACHINES

**HETTNER** Radial Drilling Machine, 10ft. elevating arm.

### GEAR MACHINES

**ORCUTT** Model HM24 Hydraulic Internal Gear Grinder.

**GLEASON** 3in. Straight Bevel Gear Generator

### GRINDING MACHINES

**CRAVEN** Roll Grinding Machine, capacity 20in. swing x 18in. between centres.

**CHURCHILL** Model HBY Internal Grinding Machine.

**CHURCHILL** Plain Cylindrical Grinding Machine, 26in. swing x 84in. between centres (1951).

**LANDIS** Type C Plain Hydraulic Cylindrical Grinding Machine, 6in. swing x 18in. between centres.

**ORCUTT** Model HM24 Internal Spur Gear Grinding Machines.

**CHURCHILL** Plain Hydraulic Cylindrical Grinding Machine, 20in. swing, x 72in. between centres.

**BROWN & SHARPE** Plain Cylindrical Grinding Machine, 10in. swing x 36in. between centres.

### MILLING MACHINES

**CINCINNATI** Model 5/72 Plain Hydromatic Milling Machine, table 9 1/2in. x 22in. (1952).

**CINCINNATI** No. 2L Plain Horizontal Milling Machine, table 52in. x 10in.

**CINCINNATI** No. 1M Vertical Milling Machine.

**CINCINNATI** No. 4 Dial Type Horizontal Milling Machine.

**PRATT & WHITNEY** Model BL3620 3-spindle "Keller" Die Sinking Machine.

**CENTEC** Model 3R Automatic Production Milling Machine, table 25in. x 16in.

### MISCELLANEOUS

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**TAYLOR & CHALLIN** Double Sided 50-ton Geared Power Press, 10in. stroke.

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WEBSTER & BENNETT Series D 36in. Single Column Type Vertical Boring Mill.

### SLOTING MACHINE

ORMEROD 12in. stroke Slotting Machine, 27in. dia. rotary table.

### LATHES

POLCHESTER 8 1/2in. Mascot S.S. & S.C. Gap Bed Lathes, to admit 6ft. 6in. between centres.  
GRAVEN 15in. S.S. & S.C. Lathe, to admit 10ft. between centres.  
DEAN, SMITH & GRACE Surfacing and Boring Lathe, with hexagon turret, swing over bed 24in., swing in gap 36in.  
GRAVEN 15in. S.S. & S.C. Lathe, to admit 25ft. between centres. Two saddles.

### MILLING MACHINES

MILWAUKEE Model 2K Heavy Duty Dial Type Vertical Milling Machine, working surface of table 56in. x 12in.  
ST. ANDRE Horizontal type Heavy Duty Plain Milling Machine, table size 73in. x 16in.  
VICTORIA V3 Vertical Milling Machine, swivel head, power feeds and rapid traverses to table in all directions, working surface of table 60in. x 12 1/2in.  
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CINCINNATI 10 ton Vert. Single Ram Hydraulic Surface Broaching Machine, 66in. stroke, 20in. x 20in. table.

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JONES & SHIPMAN Fig. 540 18in. x 6in. Hydraulic Horizontal Spindle Surface Grinding Machine, with 14in. x 6in. magnetic chuck.  
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WARD 7 Combination Turret Lathe.  
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**BRITISH AMERICAN AND CONTINENTAL  
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### AUTOMATICS

**SINGLE SPINDLE**  
HERBERT No. 4 Chucking.  
**MULTI SPINDLE**  
CONOMATIC (U.S.A. Built)  
4 Sp. 4 1/2 in. Cap.  
GREENLEE 6 Sp. 1 1/2 in. Cap.

CONOMATIC 6 Sp. 1 1/2 in. Cap.  
B.S.A. GRIDLEY 4 Sp. 3/4 in. Cap.  
GRIDLEY 6 Sp. 7/8 in. Cap.  
(choice of two).



### LATHES

**CAPSTAN, COMB, TURRET LATHES**  
LIBBY 2H Comb. Hole in spindle 8in.; 5/165 r.p.m.  
LIBBY 1HS Comb. Hole in spindle 5 1/2 in. Power and rapid feeds to saddle, Turret and Cross slide.  
GISHOLT 2L Comb. 22in. swing. 1952 built.  
HERBERT 2I Comb.  
WARD 10B Comb. Power feed to turret, Air Ball Chuck, Bar Feed Equipment Rebuilt.  
HASSE & WREDE 3-670I Comb. Hole in spindle 4 1/2 in. (Selection of seven.)  
HASSE & WREDE 3-565I Comb. Hoe in spindle 2 1/2 in. (Choice of three.)  
GISHOLT No. 4, Chucking Capstan. Power feeds, 39 to 500 r.p.m.

### CENTRE LATHES

SWIFT 13in. by 132in.; 3-6 to 220 r.p.m. Straight Bed.  
SPRINGFIELD 12in. by 48in.; 9 to 380 r.p.m. Straight Bed.

SCULFORD 12in. by 70in.; 12-5 to 1,000 r.p.m.  
DEAN, SMITH & GRACE 12in. by 66in.; 19 to 418 r.p.m. Straight Bed.  
PROGRESSIVE 11in. by 120in. 20 to 516 r.p.m. Gap Bed.  
SWIFT 10 1/2 in. by 96in.; 11 to 400 r.p.m. Straight Bed.  
MONARCH 20in. swing 96in. B.C. 12 to 180 r.p.m. Straight Bed.  
DEAN, SMITH & GRACE 8 1/2 in. by 50in.; 11 to 490 r.p.m. Straight Bed.  
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HOLBROOK 8 1/2 in. by 42in.; choice of two. Straight Bed.  
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**HORIZONTAL**  
PEARNS RICHARDS No. 3.  
RICHARDS HB.2A 3in.  
Travelling Spindle (choice of four).  
RICHARDS HBF.1 2 1/2 in.  
Travelling Spindle and Facing Head.

KEARNS OC 2 1/2 in. Travelling Spindle (Choice of three).  
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VICTORIA U.3 Table 60in. by 12 1/2 in.; 20 to 1,020 r.p.m.  
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MILWAUKEE 3H, table 64in. by 13 1/2 in.; 20 to 1,000 r.p.m.  
MILWAUKEE 2K, 15 to 1,500 r.p.m. (Choice of two.)  
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CINCINNATI 2/24 Production.  
CINCINNATI O8, table 18 1/2 in. by 6 1/2 in.; 75 to 1,100 r.p.m. Production. (Choice of two.)  
BROWN & SHARPE No. 2B table 50in. by 12in.; 15 to 276 r.p.m.  
ADCOCK & SHIPLEY Rack Feed Model OO.  
ADCOCK & SHIPLEY Rack Feed Model O.

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HERBERT 28V table 85in. by 28in.; 12 to 360 r.p.m.  
HERBERT 47, 21 to 750 r.p.m.  
CINCINNATI 4 HP table 78 1/2 in. by 16 1/2 in.; 17 to 480 r.p.m. (Choice of two.)  
CINCINNATI No. 4 table 78 1/2 in. by 16 1/2 in.; 18 to 450 r.p.m. Power down feed. (Choice of two.)  
CINCINNATI No. 3 Dial Type, table 62 1/2 in. by 15 1/2 in.; 18 to 450 r.p.m.  
CINCINNATI No. 2 table 52 1/2 in. by 12 1/2 in.; 20 to 500 r.p.m.  
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**PLANO**  
KENDALL & GENT table 5ft. 0in. by 4ft. 0in. by 4ft. 6in.  
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MACHINE TOOLS

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ARCHDALE 4ft. 0in.; 60 to 1,500 r.p.m. (Choice of four.)

ASQUITH ODI 4ft. 0in.; 16 to 430 r.p.m.

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KITCHEN & WADE 4ft. 0in.

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POLLARD CORONA 1 1/2 in. cap.; 642 to 12,040 r.p.m.

Bench. (Selection of several)  
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### GEAR MACHINES

GLEASON No. 24 Straight Bevel Generator S/N 17920.  
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MAAG SS60X Max. Dia.

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FELLOWS Model 712/7 type HS Spur Gear Shaper S/N 24766.

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CINCINNATI 10ft. by 3ft. by 3ft. Planer with 2 tool heads on cross rail and one side head. S/N 5990.

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**H. BELL (Machine Tools) LTD., Walter Street, LEEDS 4.**

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**Archdale 5ft. 0in. Elevating Arm** Radial Drilling Machine.

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**Newall 24in. x 36in. Jig Borer** with comprehensive equipment—first class condition.—C. DUGARD, LTD., Denmark Villas, Hove 32471

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**BENNIE** Horizontal Beam Straightening and Bending Machine. All steel construction. Cap. 15in. H.P. Motor 15. 1951.

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Punching Press with "Udal" automatic safety guard. Pressure 25 tons. Stroke 14in. Centre to back 74in. Bed 14½in x 11½in. Hole in bed 10in. x 7½in.—F. J. EDWARDS LTD., 359, Euston Road, London, N.W.1, or 41, Water Street, Birmingham 3.

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Type L12 Series 3800. Variable stroke 4in. to 24in. Table 16in. x 20in. with 6in. hole. Throat 7in. Motorised 400/3/50. Udal guards fitted. Pneumatically operated. Albert Trippel High Precision Universal Grinding Machine. Model M.U.S. 100. Centre Height 24in. x 4in. between. Internal Capacity 4in. to 1½in. dia. at 45,000 r.p.m. —1/64in. to 35/64in. dia. at 60,000 r.p.m. Turbine Drive. Horizontal attachments, collets, Mistair Vapour Unit. Standard Electric. Excellent condition.—ROLLS TOOLS LTD., Pyrford Road, Woking. Byfleet 43252.

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B.M.W.13 13mm. single spindle.  
PITTLER 12mm. Swiss type.  
AEB BECHLER 4 tools, 2 spindle attachment, slotting attachment.  
AE4 BECHLER 1 spindle attachment.  
2 GIBBS Swiss Type 4in. Capacity.  
2G BROWN & SHARPE 3 slide machines, 1 1/2in. capacity, 8,000 series.  
CLEVELAND Model A. 2 1/2in. capacity.

### MULTI SPINDLE AUTOMATICS

4in. B.S.A. ACME GRIDLEY RA6 spindle. Screwing spindle, Collets and Tooling. 3 available. 1944-1948.  
1 1/2in. CONOMATIC 8 spindle with screwing spindle, thread rolling, tooling and collets.  
1in. NEW BRITAIN GRIDLEY 6 spindle, Model 60.  
1 1/2in. ACME GRIDLEY 6 spindle Bar Auto.  
7in. ACME GRIDLEY 4 spindle, G Model Bar Auto (Cheap)

### COMPRESSORS

New B.E.N. Compressors in stock, type VR 32 cfm, 100 lb. working pressure and type VR 41 cfm 100 lb. working pressure.

### CUTTING OFF MACHINES

BALLINGER Abrasive type C.  
CLIFTON & BAIRD Cold Saw, Hydraulic feed. Saw 18in. dia. and clamp.

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HERBERT J TYPE. Single Column and two column machines.  
ARCHDALE Snout Type Electrically Controlled Vertical Borer. 50 Int. Taper.  
LELAND GIFFORD 2 Spindle No. 2 Morse Taper.  
ASQUITH Horizontal Duplex M/c. No. 5 Morse, 5ft. dia. Rotary table.  
ARCHDALE 2 spindles, mounted on a bridge with swivelling and centre distance adjustment. Power traverse to quills. No. 4 Morse. Table 92in. by 13in. working surface.

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HAHN & KOLB 26in. dia. with Coolant Filter Plant. Reconditioned.  
PETER WOLTERS Hydraulic. Two Spindle Vertical Honing Machine.

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TOWN 5ft. Radial.  
ARCHDALE Light Sensitive 36in. Rise and Fall Table. No. 3 Morse.  
ASQUITH 6ft. D.C. Drive—Cheap.

### GEAR HOBBING MACHINES

PFAUTER type R00.  
MIKRON type 79.  
CLEVELAND 130D.  
BARBER COLMAN No. 3.  
GLEASON 3in. Bevel Gear Generator and equipment.  
LORENZE 500 High Speed Gear Shaper, Rebuilt.

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PRECIMAX SP 1 1/2, 7in. by 12in.  
PRECIMAX MPO., 6in. by 24in. Plunge  
NORTON 6in. by 24in.  
CHURCHILL 6 by 18 Hydraulic feed, hydroauto bearings.  
CHURCHILL 10in. by 48in.

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DOALL 20in. by 6in. Hydraulic Feed.  
JONES & SHIPMAN Fig. 540. 6in. by 18in.  
BLANCHARD 10C. 16in. Magnetic Rotary Table.

### GRINDERS—UNIVERSAL

JONES & SHIPMAN 10in. by 27in.  
LANDIS 12in. by 36in.  
HENRI KAESER Model L. 10 by 20.  
BROWN & SHARPE No. 13.

### LATHES

BINNS & BERRY A.G.H. 10in. centres & 6ft. between, 36in. in gap. Speeds 22-490.  
PRATT & WHITNEY A.G.H. 6 1/2in. by 30in.  
TRIDENT Gap Bed Lathe. 6 1/2in. by 30in.  
WARD HAGGAS & SMITH faceplate Lathe, 57in. swing, 64in. in gap. Short bed with adjustable gap.  
LE BLOND Production Lathe, 7in. centres by 36in. between.  
TRIDENT Gap Bed 6 1/2in. by 60in.

### CAPSTAN AND TURRET LATHES

HERBERT No. 4  
HERBERT No. 0.  
HERBERT No. 13 Bar Turret.

All Electrics 400/3/50.

### Capstan and Turret Lathes (cont.)

GISHOLT No. 3 A.G.H. Capstan (Collet).  
GISHOLT No. 3 Simplified Capstan.  
MODERN No. 1.  
WARNER & SWASEY No. 1.  
WARD No. 8 Combination covered bed, chucking.  
WARD No. 7 Combination. Uncovered Bed.  
WARD No. 7 Capstan Lathe, covered bed, air chucking. Equipment fitted.  
WARD 3A Capstans.  
WARD 2A Capstans.

### MILLING MACHINES

CINCINNATI 08 Vertical.  
THIEL Model 58 Tool Room Mill.  
WADKIN High Speed Vertical, Table 35in. by 13in.  
OERLIKON FV.2 Vertical swivel head.  
CINCINNATI No. 3 Vertical Sliding head.  
ALEXANDER No. 2, 3 Dimensional Pantograph Machine.

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HILLE 6in. O/D Max.  
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ARCHDALE with 120 Hobs.  
WANDERER. 3in. capacity.

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TAYLOR & CHALLENGE Type 1413 40 ton Variable stroke—Guards.  
85-ton RHODES Upright Geared.  
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25-ton RHODES Inclined.  
35-ton RHODES Inclined.  
BLISS No. 8 Power Press.  
FLY PRESSES Nos. 3, 4, 5, 6.  
HENRY & WRIGHT Dieing Press, 25 tons.  
L.M.E. 12-ton variable stroke, pneumatic operator's guard.

### SHAPERS

ESSEX Punch Shaper with Microscope and equipment.  
ALBA 45 18in. stroke.  
ALBA 10in. stroke.

### SLOTTERS

BUTLER RAPID 8in. Tool Room Machine.  
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**ROLLS TOOLS LTD. No. 1 Factory, Pyrford Road, Pyrford, Woking**

Contact Mr. P. W. Gander Telephone: Byfleet 43252/3 & 41456

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Classified Advertisements (PLANT FOR SALE, contd.)

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**POTTER & JOHNSON 4D Chucking Auto.**  
Well equipped

### BENDING ROLLS

**RHODES 6ft. x 14 gauge Power Bending Rolls.**

### CROPPING MACHINES

Double Ended Angle Cropping Machine.  
Capacity up to 6in. x 1/2in. angles.

### DRILLING MACHINES

**AMERICAN 6ft. H/Duty Radial Drill.**  
No. 6 M.T. Older machine, good condition. 400/3/50 sep. motor.

### FOLDING MACHINES

**EDWARDS 6ft. x 1/2in. High Lift Swing Beam, Universal Folder.**

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New N.I. 10in., 12in., 14in., 16in. and 20in.  
D/E Tool Grinders.

### GUILLOTINES

**RUSHWORTH 4ft. x 1/2in. O/Crank Guillotine.** Little used.

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**EDGWICK Keyseater.** Stroke 4 1/2in. Table 26in. x 9in.

### LATHES

**HERBERT No. 4 Capstan.** 2 1/2in. H/Spindle. Speeds to 611.

### MILLING MACHINES

**MILWAUKEE 3H Vertical Milling Machine.** Table 64in. x 13 1/2in.

**MILWAUKEE 3H Horizontal Milling Machine.** Table 64in. x 13 1/2in.

### NIBBLERS

**SURFREE 2A Nibbling Machine.** Capacity 1/2in. M/8.

**W.F. 14 Gauge Nibbler.** 59in throat

### PRESSES

**TAYLOR & CHALLENGE "370" 20 Ton O/F Press.**

**TAYLOR & CHALLENGE "845" Dial Feed Notching Press.** Capacity 6 tons.

**TAYLOR & CHALLENGE "1455" Dial Feed Notching Press.** Capacity 2 tons.

**BRADLEY & TURTON No. 3 Flypress.**

**SWEENEY & BLOCKSIDE Bench Press.** Capacity 3 tons.

### SAWING MACHINES

**BARSON No. 1 Saw.** 1 1/2in. rounds, 2in. tubes, 1 1/2in. x 1/2in. flats, 1 1/2in. x 1/2in. angles.

### SCREWING MACHINES

**KENDALL & GENT 3in. Screwing Machine.** Leadscrew type.

### SHAPING MACHINES

**TOWN 26in. H/Duty Shaper.**

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**S and S h.p. Double Ended Polishing Spindles.**

### WELDING EQUIPMENT

**PRESBOTT 15 kVA Spot Welder.**

All machines 400/3/50 electrics unless otherwise stated

### THE

**MIDLAND MACHINE TOOL CO.**

BRADLEY, BILSTON, STAFFS.

Tel.: Bilston 43471/9

## New for Immediate Delivery

**CENCO Model 2B Precision Milling Machine.** Power feed to Table.

Further details from:

C. & G. OLDFIELD, Ltd.  
15, Abercorn Street,  
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**TWO NEW LEN25/250 High Speed Open Fronted Inclinable Power Presses.** With adjustable stroke. Motorised for 400/440/3/50 supply. Pressure exerted 25 tons. Depth of throat 8 1/2in. Table 16 1/2in. x 22 1/2in. Hole in table 8 1/2in. Stroke adjustable from 1/2in. to 3 1/2in. Weight approx. 35 cwt.

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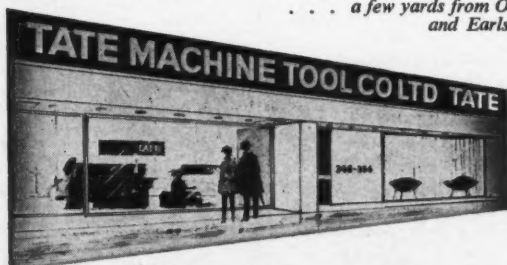
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If you do not wish your reply to any Box No advertisement in this section to be forwarded to certain firms, please advise us. Your reply will then be destroyed, but you will not be notified as this would disclose the identity of the advertiser.

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**Foreman for Small Machine**  
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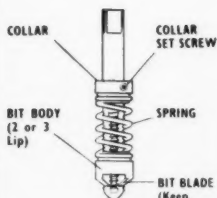






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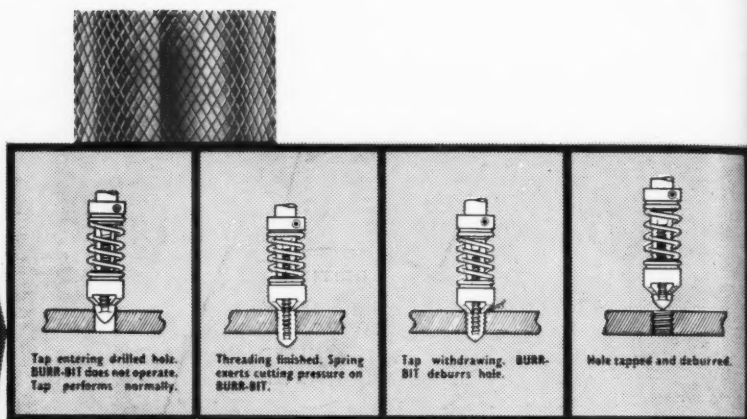


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